M5 Junction 10 Improvements Scheme

Transport Assessment

Appendix L - Traffic Forecasting Report

Regulation 5 (2) (q)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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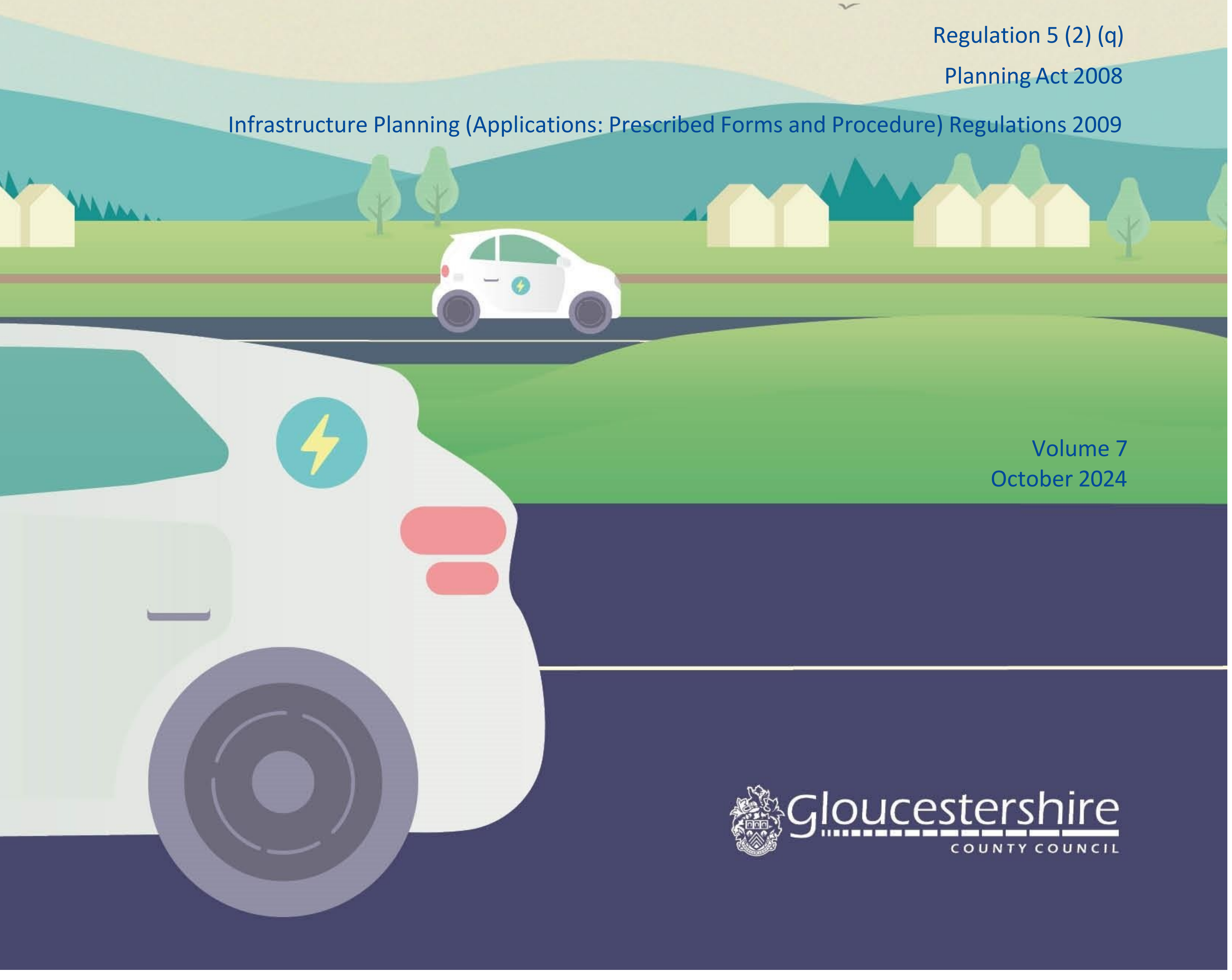

Gloucestershire County Council

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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7.5 Transport Assessment Appendix L – Traffic Forecasting Report

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1. Introduction

1.1. Scheme Background

1.1.1. Gloucestershire faces significant challenges to achieve its vision for economic growth. A Joint Core Strategy (JCS) – a partnership between Gloucester City Council (GCC), Cheltenham Borough Council and Tewkesbury Borough Council was formed to produce a co-ordinated strategic development plan to show how the region will develop during the period up to 2031. This includes a shared spatial vision targeting 35,175 new homes and 39,500 new jobs by 2031. Major development of new housing (c.9,000 homes) and employment land (c.100ha) is proposed in strategic and safeguarded allocations in the West and North West of Cheltenham, much of which lies within Tewkesbury Borough Council. This, in turn, is linked to wider economic investment, including a government supported and nationally significant Cyber Park 2 adjacent to GCHQ, predicted to generate c.7,000 jobs.

1.1.2. However, to unlock the housing and job opportunities, a highways network is needed that has the capacity to accommodate the increased traffic it will generate, within a sustainable transport context. A Business Case was submitted in March 2019 to the Housing Infrastructure Fund (HIF), wherein an investment case was made for the following infrastructure improvements, which together make up the M5 Junction 10 Improvement Scheme:

- An all-movements junction at M5 J10;
- A new Link Road from A4019 to West Cheltenham Cyber Park;
- Dualling of the A4019 to the East of the M5 J10;
- A38/A4019 junction improvements at Coombe Hill; and
- Extension of Arle Court Park & Interchange Hub.

1.2. Purpose of the Report

1.2.1. This report encapsulates all the analytic material underpinning the future year traffic forecasts, including the forecast year sections of the transport model. It includes the flows and speeds on the network as well as assumptions, such as the uncertainty log, that were used to forecast travel demand in future years.

1.2.2. This document presents the PCF Stage 3 'Transport Forecasting Package' for the M5 J10 Improvement Transport Scheme. The appraisal of the scheme is underpinned by the Gloucestershire Countywide Traffic Model (GCTM) – a bespoke SATURN highway assignment model developed for scheme appraisal and land use strategy testing on behalf of GCC.

1.2.3. The latest version of the GCTM, adopted for PCF Stage 3 is identified as Version 2.3, which supersedes previous versions. Full details of the GCTM V2.3 base model development and validation are summarised in the Transport Model Package Report (GCCM5J10-ATK-HTA-ZZ-RP-TR-000003).

1.2.4. This report presents the methodology for developing the different scenario forecast assignments (in terms of the scenarios P, Q, R and S) followed by the analysis of the dependent development impacts.

1.3. Location of the Scheme

1.3.1. M5 J10 is located 48 miles to the south of Birmingham, five miles to the south of Tewkesbury, four miles to the north-west of Cheltenham, and eight miles to the north-east of Gloucester. It is the northernmost of four junctions serving the Gloucester and Cheltenham urban areas.

1.3.2. The junction is placed in a strategically important location for the region, particularly as northern and western Cheltenham are the sites of several retail parks, employment areas, and the location of planned future housing and nationally significant business development.

1.3.3. The locations of the proposed infrastructure improvements that make up the M5 J10 Improvements Scheme are illustrated in Figure 1-1 below.

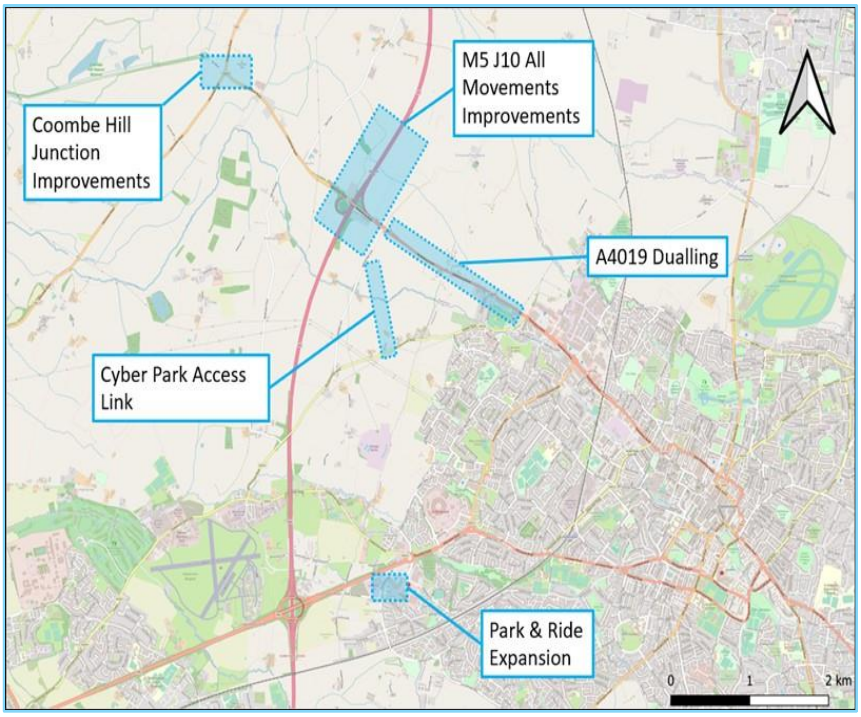


Figure 1-1 – M5 Junction 10 Improvement Scheme Elements

1.3.4. The JCS process identified improvements to the local and strategic transport network to enable the planned growth, which included upgrading Junction 10 of the M5 to all movements with associated improvements to surrounding transport infrastructure, collectively identified as the Junction 10 Improvements Scheme. This scheme includes the following measures:

- An all-movements junction at M5 J10 (replacing the existing north-facing slips-only arrangement);
- A4019 widening, east of Junction 10 including a bus lane on the A4019 eastbound carriageway from the West Cheltenham Fire Station to the Gallagher Retail Park Junction;
- A38/A4019 junction improvements at Coombe Hill;
- A new link Road from A4019 to the West Cheltenham development/Cyber Park; and
- Extension of Arle Court Park & Interchange Hub.

1.3.5. In the case of the M5 J10 Improvements scheme, the focus of the transport scheme is to improve access and unlock the full development of the North West and West Cheltenham strategic allocations (as contained in the overarching land use plan, the JCS developed by Cheltenham, Gloucester and Tewkesbury districts) and additional development at land safeguarded for future development under the JCS at North-West Cheltenham. The locations of these sites are shown in Figure 1-2.

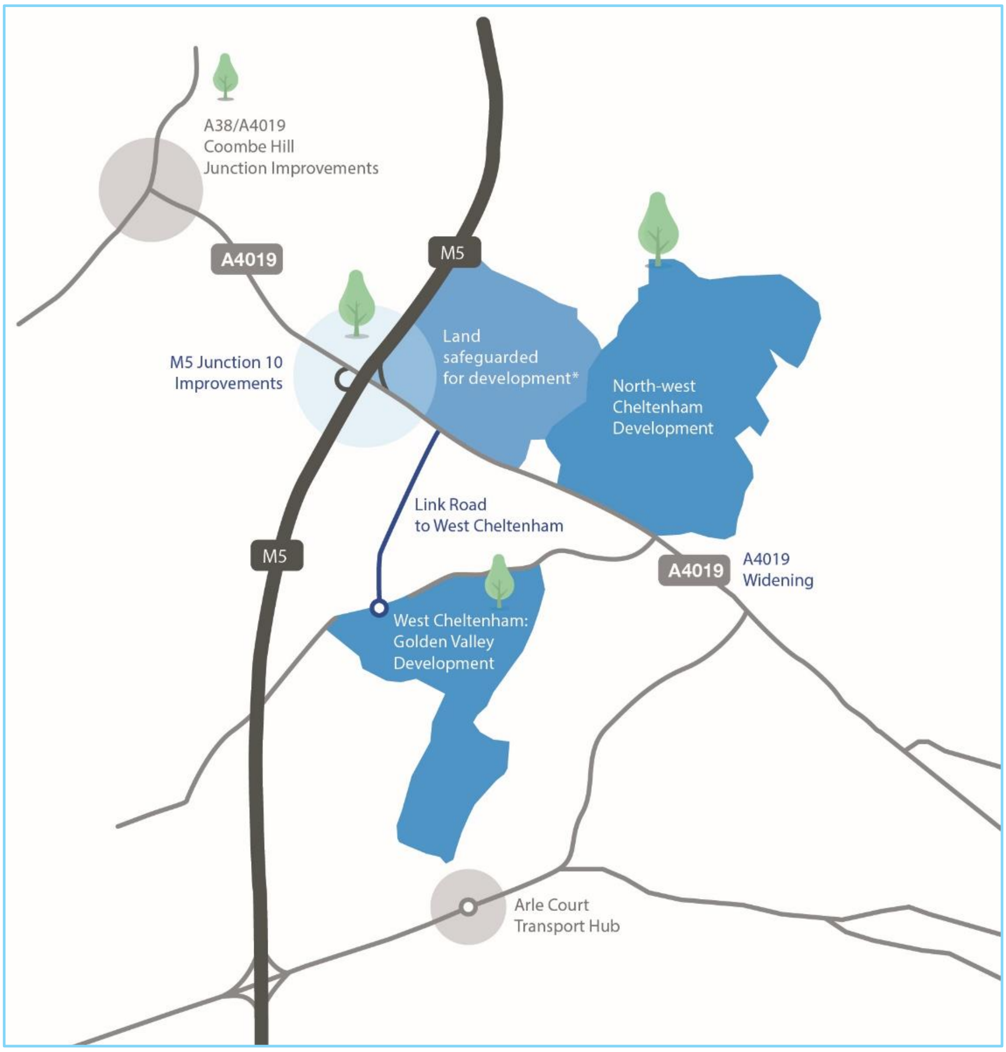


Figure 1-2 – North West and West Cheltenham Site Locations

1.4. PCF Stage 3 Traffic Forecasting Package components

1.4.1. The Transport Forecast Package is a single report structured as follows:

- Chapter 2 – Provides an overview of the GCTM and the forecasting approach adopted.
- Chapter 3 –Details the development of the reference case forecast matrices;
- Chapter 4 – Provides details of the forecast network development process for both the 'Scenario P, Q' (without Transport scheme) and 'Scenario R, S' (with Transport scheme) options for assessment together with the reference case assignment methodology;
- Chapter 5 – Sets out the application of the variable demand model and assignment methodology;
- Chapter 6 – Presents the results of the core scenario model assignments;
- Chapter 7 – Details of the sensitivity tests and traffic model outputs provided for other disciplines; and
- Chapter 8 – Provides conclusions to the report.

2. Model Description and Forecasting Approach

2.1. Overview

2.1.1. This chapter provides an overview of the GCTM Version 2.3 (GCTM V2.3) model used for the appraisal of the scheme and the forecasting approach adopted in developing the scenarios for the assessment of the M5 J10 Transport Scheme.

2.2. The Need for the Model

2.2.1. The scheme proposal involves the upgrading of Junction 10 of the M5 to all movements with associated improvements to surrounding transport infrastructure, as listed in section 1.3.4. The M5 represents the key strategic link connecting the South West of England to the West Midlands and wider UK highway network whereas the A4019 also forms an important corridor, linking Cheltenham town centre and the M5 at a strategic level.

2.2.2. The GCTM was identified as the most suitable tool available for the appraisal of the proposed scheme. The GCTM is a strategic SATURN model, developed specifically for GCC's usage in assessing major highway interventions and land use strategies across the Gloucestershire region. It is derived from the National Highways A417 Missing Link Stage 2 traffic model, which itself was developed from the South West Regional Traffic Model (SWRTM).

2.2.3. However, a key issue identified with Version 1.0 of the GCTM (GCTM V1.0) was that it did not contain enough network or zonal detail within the area around M5 J10. There was also a limited level of model validation undertaken in the area.

2.2.4. GCC commissioned Atkins to extend the Gloucestershire Countywide Traffic Model (GCTM V1.0), to provide a strategic modelling tool capable of conducting initial options testing for the proposed M5 Junction 9/A46 (Ashchurch) scheme. This extended model was referred to as GCTM Version 2.0 (GCTM V2.0).

2.2.5. The GCTM V2.0 was further refined to address the comments from National Highways. This update of GCTM is referred to as GCTM Version 2.1 (GCTM V2.1).

2.2.6. GCTM V2.1 was further amended in the subsequent stage of the M5J9 scheme assessment, by adjusting speed flow curve capacities along the A46 east of Teddington Hands Roundabout and around Evesham to refine the representation of traffic impacts associated with the M5 Junction 9 and A46 (Ashchurch) Transport Scheme. This update to the GTCM model is referred to as GCTM V2.2.

2.2.7. The GCTM V2.2 was adopted as a starting point for M5J10 Stage 3 modelling. A detailed study of GCTM V2.2 was carried out and the model was further refined in the areas surrounding A4019 for the highway network and zoning system. This update of the GCTM Model is referred to as GCTM V2.3. These findings and updates are in the M5 J10 Model Package report (GCCM5J10-ATK-HTA-ZZ-RP-TR-000003).

2.2.8. Key details of the GCTM Version 2.3 model specification (including a high-level summary of the key enhancements made to the model to meet the design requirements) are provided in the following section.

2.3. Base Model Overview

2.3.1. This section provides an overview of the GCTM Version 2.3 base model and its preparation for use in developing forecast scenarios for the assessment of the M5 J10 Transport Scheme.

Model base year

2.3.2. Consistent with previous versions of the GCTM and the A417 Missing Link Parent Model, Version 2.3 of the GCTM reflects 2015, average March weekday traffic conditions and is calibrated and validated against corresponding traffic levels and journey times.

Modelling system and software

2.3.3. GCTM Version 2.3 has been developed using SATURN Version 11.4.07H. SATURN is regarded as the industry standard strategic highway assignment modelling software. The modelling system uses the same TAG-based approach as adopted for the SWRTM and A417 Missing Link models. It therefore comprises:

- Trip end model – used for estimating the number of trips generated/attracted by a specific zone;
- Demand model – used for estimating how travellers respond to changes in their travel costs; and
- Highway assignment model – used for estimating travel costs and identifying the routes travellers may choose through the road network.

Time periods

2.3.4. The highway assignment model includes four weekday time periods as shown in Table 1. These time periods remain consistent with the original SWRTM.

Table 1 – Model Time Periods

Model Time Period	Temporal Coverage
AM weekday average hour	0700 – 1000
IP (Inter Peak) weekday average hour	1000 – 1600
PM weekday average hour	1600 – 1900
OP (Off Peak) weekday average hour	1900 – 0700

2.3.5. As per GCTM Version 1, only the three daytime periods are subject to calibration and validation, with the Off Peak (OP) model simply used as an alternative method for factoring from modelled periods to daily levels. This model has been produced by factoring the inter-peak matrix based on observed traffic count data.

2.3.6. Average hourly flows were converted to *worst peak hour* flows for Operational assessment. This is further explained in detail in Chapter 7.

User classes

2.3.7. The GCTM Version 2.3 adopts the same five user classes as used in the original GCTM. The user classes are set out in Table 2.

Table 2 – User Class Definitions

User Class Number	Vehicle Type	Purpose
1	Car	Employer's Business
2	Car	Commuting
3	Car	Other
4	Light Goods Vehicle (LGV)	Includes Personal and Freight
5	Heavy Goods Vehicle (HGV)	Freight/Business

2.3.8. The different user classes allow the model to take into account differences in users' Value of Time (VoT) and Vehicle Operating Cost (VOC). For example, Heavy Goods Vehicles have different VOCs in comparison to cars and LGVs. Car trips are divided into three trip purposes as the value of time differs between them i.e., vehicles on business trips are likely to have a higher value of time than, for example, a vehicle on a journey for leisure purposes.

Passenger Car Units

2.3.9. The vehicle to PCU conversion factors used for the various user classes are summarised in Table 3. These were maintained same as the donor model A417 Missing Link.

Table 3 – PCU Factors by Vehicle Type

Vehicle Type	Description	PCU Factor
Car	Private car	1.0
Light Goods Vehicle	Goods vehicle using car-based chassis	1.0
HGV	Heavy Goods vehicle	2.5

2.4. Forecasting Methodology

2.4.1. The forecasting approach applied for the PCF Stage 3 assessment draws on the following DfT TAG documentation:

- TAG unit M2.1 variable demand modelling (May 2020); and
- TAG unit M4 forecasting and uncertainty (May 2023).

2.4.2. The approach to forecasting is to first create *Reference Case (RC)* forecast matrices which reflect changes in population, employment, car ownership and other demographic as well as economic factors. The RC forecasts do not take into account the impact of changes in travel costs between the base year and the relevant forecast year. However, they provide a useful function in indicating how traffic demand would be likely to grow if network conditions and travel costs were held constant in the future.

2.4.3. Changes in the Generalised Costs (GC) between the base year and the future year scenarios are then considered through Variable Demand Modelling (VDM). The VDM process modifies the RC forecasts to reflect the impacts of increasing congestion on the road network in the Do-Minimum (DM), and then relief of congestion in the Do-Something (DS) scenario.

2.4.4. Stage 3 traffic forecasts are based on the TAG Unit A2.2 'Induced Investment' appraisal approach, which requires the creation of modelling scenarios P, Q, R & S. The following scenarios are modelled for forecast years of 2027,2034 and 2042:

- Scenario P – Without dependent development (but including deadweight) and without the transport scheme
- Scenario Q – With dependent development (including deadweight) and without the transport scheme
- Scenario R – With dependent development (including deadweight) and with the transport scheme
- Scenario S – Without dependent development (but including deadweight) and with the transport scheme

2.4.5. The four modelling scenarios are based on two demand scenarios, where P/S demand includes deadweight but excludes dependent development and Q/R demand Includes deadweight and dependent development.

2.4.6. The overall forecasting approach is summarised in Figure 2-1.

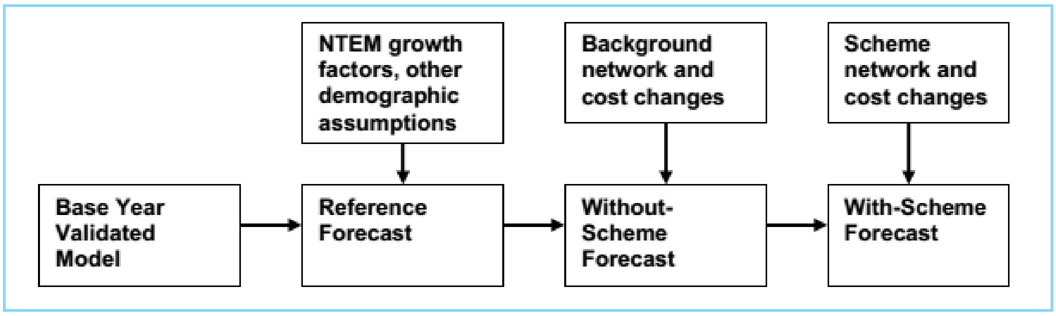


Figure 2-1 – Overview of the forecasting process

2.4.7. Future year models have been developed for:

- 2027 (planned opening year);
- 2034; and
- 2042 (Design year)

2.4.8. The development and outputs of the opening year (2027) and design year (2042) forecast models are detailed in this report. A third forecast year model namely 2034 was developed primarily as an intermediate future year to provide a more accurate growth profile between the opening and design years in the economic appraisal. Whilst the various aspects of 2034 forecast model development such as growth factors are outlined in this report the presentation of the model outputs is limited to the opening year (2027) and design year (2042) of the scheme.

2.5. Uncertainty

2.5.1. TAG Unit M4 sets out the guidelines for the treatment of uncertainty in model forecasting. Determining uncertainty around input assumptions on demand forecasts is used to develop and assess alternative scenarios.

2.5.2. The guidance anticipates that a 'core' scenario will be developed and to account for future uncertainty, a range of sensitivity tests or alternative scenarios will also be developed.

2.5.3. The key issues in assessing uncertainty are:

- The range of possible inputs;
- The likelihood of each input; and
- The interaction between different elements which affects inputs.

2.5.4. In order to analyse uncertainty, it is necessary to create an uncertainty log. This log highlights all the local and external uncertainties and factors likely to affect the traffic/patronage, revenues and delivery of scheme benefits.

2.5.5. The uncertainty log includes an assessment of the uncertainty of each individual input by placing it into one of four categories, as defined in Table 4 (from TAG Unit M4, Appendix A, Table A2).

Table 4 – Classification of Future Inputs

Probability of the Input	Status
Near Certain: The outcome will happen or there is a high probability that it will happen.	Intent announced by proponent to regulatory agencies; Approved development proposals; and Projects under construction.
More than likely: The outcome is likely to happen but there is some uncertainty.	Submission of planning or consent application imminent; and Development application within the consent process.
Reasonably Foreseeable: The outcome may happen, but there is significant uncertainty.	Identified within a development plan; Not directly associated with the transport strategy/scheme, but may occur if the strategy/scheme is implemented; Development conditional upon the transport strategy/scheme proceeding; Or, a committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty.
Hypothetical: There is considerable uncertainty whether the outcome will ever happen.	Conjecture based upon currently available information; Discussed on a conceptual basis; One of a number of possible inputs in an initial consultation process; or a policy aspiration.

Core scenario

2.5.6. The core scenario is intended to provide the best basis for decision-making given current evidence. It must be robust to identify the key model uncertainties listed in the uncertainty log.

2.5.7. TAG recommends that local sources of uncertainty categorised as either ‘near certain or ‘more than likely’ should be included in the core scenario. Other sources categorised as ‘reasonably foreseeable’ or ‘hypothetical’ should be excluded.

2.5.8. The core scenario is therefore based on:

- NTEM growth in demand, over a suitable spatial area; and
- Sources of local uncertainty that are either ‘near certain’ or ‘more than likely’ to occur than not.

2.5.9. Forecasting into the future, the accuracy of the modelling approach declines, and uncertainty increases as the future horizon extends, for highway schemes.

2.5.10. In relation to trip matrices, the reference case core scenario assumptions and considerations of uncertainty are discussed in Chapter 3. The development of the core scenario reference case in relation to highway schemes is presented in Chapter 4.

3. Forecast Demand Development

3.1. Overview

3.1.1. This chapter records the processes followed in developing Reference Case traffic forecast matrices for the future years of 2027, 2034 and 2042.

3.1.2. The Reference Case (RC) forecast matrices are a key input to the VDM process which create the final Q scenario. The RC matrices reflect the changes in demand from the base year attributable to demographic changes such as the number of jobs in an area, the number of residents in an area and car ownership levels. They represent the travel demand that would arise if there were no changes in travel costs from the base year model.

3.1.3. The demand model then creates forecast assignments using the Reference Case matrices to extract travel costs which are pivoted off the model base year assignment. Using this methodology, the Q forecast matrices were created accounting for:

- Transport interventions between the base year and the forecast year;
- Increases in the value of time resulting from real increases in income;
- Increases in levels of congestion arising from increased car usage; and
- Increases in fuel efficiency which make car travel cheaper.

3.2. Scenario Q Demand Development Methodology

3.2.1. This section summarises the scenario Q reference demand development methodology adopted to feed into Variable Demand Model (VDM). The flow chart in Figure 3-1 below shows the methodology with main steps explained below and Section 3.3.

3.2.2. The first step was to process the uncertainty log that was made available by GCC considering only developments which are more than likely or near certain for the core scenario, as per TAG guidelines. The quantum of deadweight (developments which are not dependent on implementation of the proposed scheme) for the North West Cheltenham and West Cheltenham development sites (JCS and Safe Guarded land) were maintained at the same level as the HIF bid submission. The remainder of the development quantum considered as dependent development. This approach was agreed with GCC. A summary of developments considered from the uncertainty log at a district level is shown in Table 5 including dead weight and dependent development component for North West Cheltenham and West Cheltenham (JCS and Safe Guarded land).

3.2.3. For development trips, two sets of development trip ends were developed using the trip rates from TRICS database, where M1 consists of the trip ends for core Dwellings/Employment development sites and M2 consists of the trip ends for the combined development quantum of Deadweight and Dependent Dwellings/Employment sites shown in Table 5. M1 and M2 are added to form total development trip ends i.e., M3.

3.2.4. The new development trips for Car Business, Car Others, LGV, and HGV distributed using the trip distribution pattern of a chosen ‘donor zones’ from the existing GCTM V2.3 model. Donor zones were selected in a way that the development zone and donor zone are similar in terms of geography (location) and land use. Car Commute development trips were distributed using the distribution pattern of 2011 Census Journey-to-work trips.

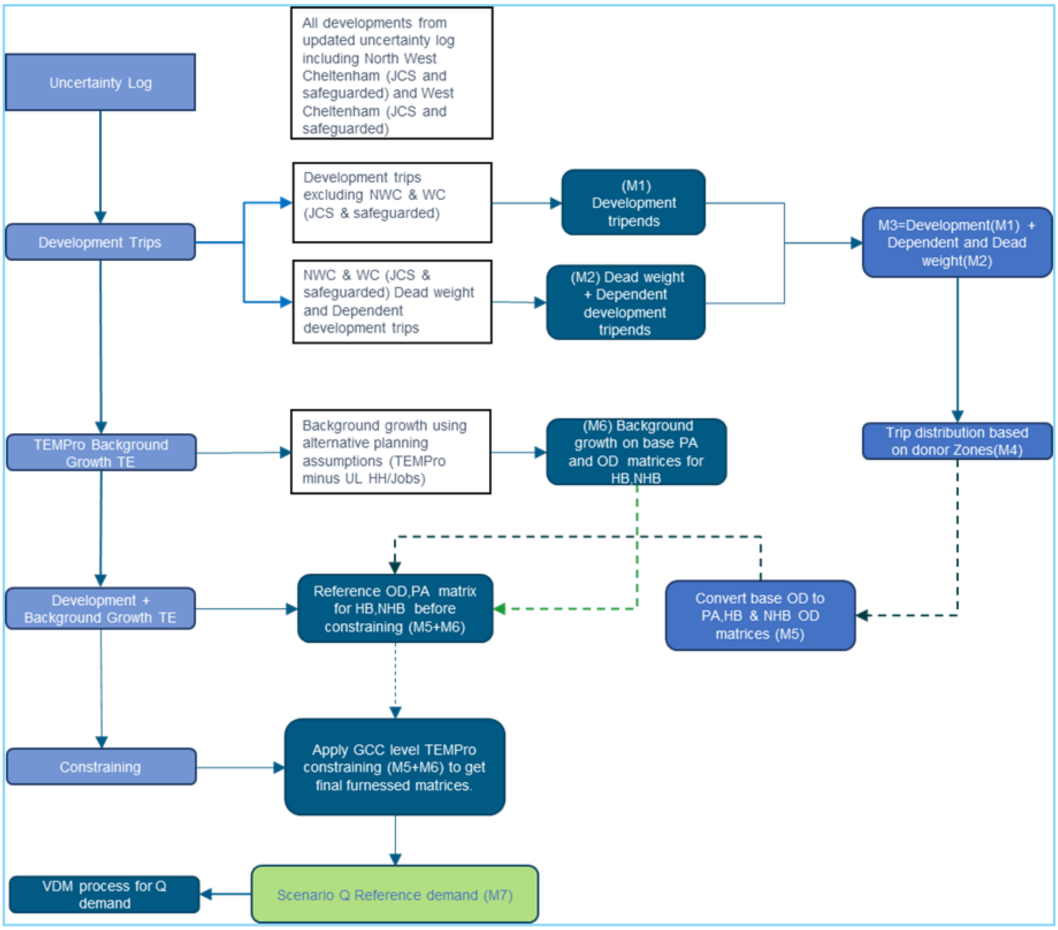


Figure 3-1 – Scenario Q Demand Development Methodology Flow Chart

3.2.5. After trip distribution the resultant OD matrix (M4) for development trips were converted to demand segments in OD and PA format for Non-home Based (NHB) and Home Based (HB) component respectively (M5).

3.2.6. To calculate the background growth, TEMPro alternative planning assumptions were utilised, where the development quantum (Households/Jobs) for core, deadweight and dependent developments were removed from TEMPro forecast year planning data to determine background growth. These growth factors were then applied on the validated base demand to produce background growth matrix (M6).

3.2.7. Development matrix (M5) and background growth matrix (M6) were added to get an interim reference Matrix. This matrix was then constrained to the overall TEMPro growth, at GCC level (All the local authorities under Gloucestershire County), to get a final reference matrix (M7), which is used as an input demand into VDM.

3.2.8. The output demand resulting from scenario Q model run as shown above is also used for scenario R model runs. The difference between Q and R scenarios is in the supply (network) where the DCO transport scheme is excluded in Q and present in R.

3.3. Development of Scenario Q Demand

3.3.1. This section summarises the scenario Q demand inputs and the detailed process adopted to develop scenario Q reference case demand for input to the VDM process.

M5 J10 Uncertainty Log

3.3.2. The development uncertainty log was provided to Atkins by GCC who collated information from local districts of Tewkesbury, Cheltenham, Gloucester City, Stroud and the Cotswolds.

3.3.3. The uncertainty log sets out all the residential, retail and employment developments to be included in the forecast year matrices, including information on the land use composition, location, size, the level of certainty, and the percentage completion in line with each of the model forecast years. Sites already completed since March 2015 (the base model period) were also included.

3.3.4. Figure 3-2 below outlines the development location for core sites, deadweight and dependent development component by the authority which will be considered while developing demand for scenarios P and Q. All development location considered are listed in Appendix A as per the uncertainty log provided by GCC.

3.3.5. Where the appropriate details were not available in the uncertainty log, the following land use assumptions were made about the employment sites:

- Where a site was partially B1 (business), the whole share for B1 was allocated solely to land use code B1a (office) and
- Where a site was partially B2 or B8 (general industrial or storage/distribution respectively), sites were split evenly across all component land use codes C, D, E, F, and G; representing Industrial Units, Industrial Estates, Warehouses (self-storage), Warehouses (commercial) and Parcel Distribution Centres respectively.

3.3.6. Table 5 outlines the development quantum for core sites, deadweight and dependent development component by authority for 2042 which was considered while developing scenario P and scenario Q demand.

3.3.7. Deadweight and dependent developments for the North West Cheltenham (NWC) and West Cheltenham (WC) JCS and Safeguarded sites, which were considered in the HIF bid and used for M5 J10 stage 3, are shown in Table 6.

Table 5 – Classification of Proposed Development inputs in 2042 for M5 J10 Stage 3 Assessment

Authority	Type	Dwellings/ Jobs - Core site	Deadweight Dwellings/ Jobs	Dependent Dwellings/ Jobs	Total Dwellings/ Jobs
Cheltenham	Housing	1,211	738	4,044	5,993
	Employment	997	2,227	11,255	14,479
Tewkesbury	Housing	8,680	973	3,312	12,965
	Employment	3,249	507	1,345	5,101
Cotswold District	Housing	5,088			5,088
	Employment	1,003			1,003
Gloucester	Housing	3,711			3,711
	Employment	1,156			1,156
Stroud	Housing	4,249			4,249
	Employment	2,616			2,616
Total	Housing	22,939	1,711	7,356	32,006
	Employment	9,021	2,734	12,600	24,355

Table 6 – Proposed Deadweight and Dependent Development for M5 J10 Stage 3 Assessment

Site Name	Scenario	HIF Deadweight Dwellings	HIF Deadweight employment Floor Space (sqm)	Dependent dwellings	Dependent employment Floor Space (sqm)	Total Dwellings	Total employment land (sqm)	Changes from earlier HIF bid
North West Cheltenham (JCS)	HIF Bid	973	9,853	3,312	33,647	4,285	43,500	
	Stage 3 Proposed	973	9,853	3,312	26,147	4,285	36,000	Dwellings: nil Employment: -7,500 sqm
West Cheltenham (JCS)	HIF Bid	102	19,245	998	186,995	1,100	206,240	
	Stage 3 Proposed	225	21,245	2,146	189,042	2,371	210,287	Dwellings: +1721 Employment: +4087 sqm
North West Cheltenham (Safe Guarded)	HIF Bid	513	27,200	1,745	92,800	2,258	120,000	
	Stage 3 Proposed	513	27,200	1,745	80,800	2,258	108,000	Dwellings: nil Employment: -12,000 sqm
West Cheltenham (Safe Guarded)	HIF Bid	123	2,000	1,201	18,000	1,324	20,000	
	Stage 3 Proposed	0	0	0	0	0	0	Dwellings: -1324 Employment: -20,000 sqm

Source: HIF_Traffic Forecasting Report – Final COGL43063120 / 002 Revision 02 (Table 11: Scenario Q Dependency Test Results)

Source: Highway Schemes Information v0.2.xlsm (GCTM V2.3 Uncertainty Log) and HIF Grant Determination Agreement (GDA) development quantum

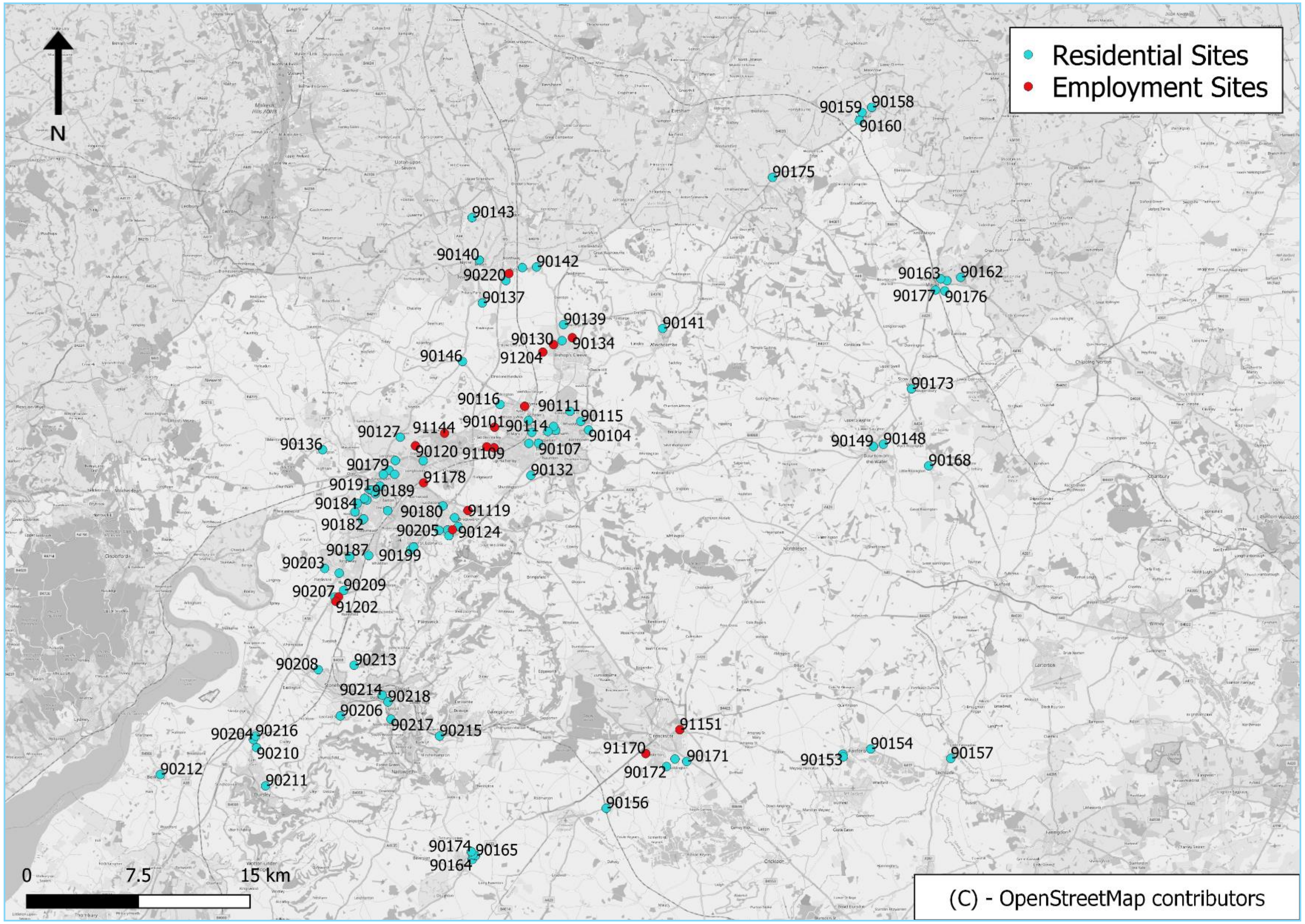


Figure 3-2 – M5 J10 development site locations (as per GCC uncertainty log)

Development trip rates

3.3.8. Trip rates for all the residential and employment sites by landuse types were extracted from the TRICS database (v7.6.3). The trip rates that were extracted and applied are presented in Table 7, per dwelling for residential sites and per 100 sqm basis for employment sites. The trip rate for the JCS Strategic Allocation Site A9 in Ashchurch, was taken directly from the Transport Assessment for the site, as the scheme is already progressing, and information is readily available with GCC. This is in line with the parallel stream of work being undertaken for M5 J9 scheme for GCC. Trip rates were also extracted for HGVs to calculate appropriate splits in each time period.

3.3.9. It is noted that the trip rates adopted correspond with the model time periods and so peak period trip rates represent average hour values (07:00- 10:00 for the AM peak and 16:00-19:00 for the PM peak) which even though are somewhat lower than peak hour trip rates but better present the peak period conditions. These trip rates were agreed with GCC as part of the M5 J9 Model extension forecasts.

Table 7 – Forecast Development Land Use Trip Rates (Total Vehicles)

Development type	Unit	AM peak period (07:00-10:00 Avg Hr.)		Inter-peak (10:00-16:00 Avg Hr.)		PM peak period (16:00-19:00 Avg Hr.)	
		In	Out	In	Out	In	Out
Residential (A)	Per dwelling	0.111	0.267	0.158	0.154	0.284	0.154
B1 (A)	100m2	0.845	0.105	0.186	0.216	0.086	0.786
B2 (C)	100m2	0.220	0.073	0.133	0.147	0.051	0.211
B2 (D)	100m2	0.265	0.126	0.185	0.192	0.117	0.245
B8 (E)	100m2	0.167	0.120	0.159	0.164	0.057	0.108
B8 (F)	100m2	0.185	0.104	0.118	0.111	0.097	0.159
B8 (G)	100m2	0.653	0.444	0.334	0.364	0.545	0.777
Retail	100m2	1.687	0.344	2.380	2.354	2.283	2.290

Note: Retail trip rate from Ashchurch Strategic Allocation Site A9 Transport Assessment, PFA Consulting, September 2013
Source: GCTM M5 Junction 9 Model Extension_TFR_v3.0 (Table 3-1)

3.3.10. The light vehicle trip rates have then been divided into cars and LGVs using a simple factor for each time period, based upon the ratio of cars to LGVs in the count database which was used in calibration of GCTM V2.3 base model.

3.3.11. The car trip rates then divided further to Business, Commute and Other purposes based upon the proportions from the TAG Databook v1.15 which was used in calibration of GCTM V2.3 base model.

3.3.12. The Car and LGV proportions for West Cheltenham and North west Cheltenham safeguarded and core zones were updated using donor zone proportions and splits. This was done to ensure residential and employment site have plausible split and distribution in the forecast models.

Development trip distribution

3.3.13. For model user classes 1 and 3 to 5 (car business, car other, LGVs and HGVs) the trip distribution of the new development zones was based upon the trip distribution in selected 'donor zones'; existing base model zones that are similar in terms of geography and land use to the new development. For user class 2 (car commuting), the trip distribution was based on the distribution of 2011 Census journey to work trips. Table 8 below shows distribution and split for selected WC and NWC zones for year 2042. While undertaking the development trip distribution, due consideration was given to incorporate inter-development trips as explained below.

Table 8 – West Cheltenham and North West Cheltenham Proportion Split for Development Zone

Time Period	Authority	Description	Donor Zone	Zone	Business %		Commute %		Others %		LGV %	
					Origin	Destination	Origin	Destination	Origin	Destination	Origin	Destination
AM	North West Cheltenham (JCS)	Residential	21231,21228	90122	5.71%	3.99%	45.21%	38.84%	41.83%	46.42%	7.24%	10.75%
		Employment	91001-91004,21226	91123	5.71%	3.99%	45.21%	38.84%	41.83%	46.42%	7.24%	10.75%
	West Cheltenham (JCS)	Residential	21231,21228	90101	5.71%	3.99%	45.21%	38.84%	41.83%	46.42%	7.24%	10.75%
		Employment	91001-91004,21226	91102	5.71%	3.99%	45.21%	38.84%	41.83%	46.42%	7.24%	10.75%
	North West Cheltenham (Safe Guarded)	Residential	21231,21228	94003	5.39%	3.38%	43.76%	31.88%	43.62%	55.70%	7.23%	9.04%
		Employment	91001-91004,21226	95003	5.61%	3.81%	44.76%	36.75%	42.38%	49.21%	7.24%	10.23%
IP	North West Cheltenham (JCS)	Residential	21231,21228	90122	7.23%	6.96%	19.58%	24.00%	66.23%	61.75%	6.96%	7.29%
		Employment	91001-91004,21226	91123	7.23%	6.96%	19.58%	24.00%	66.23%	61.75%	6.96%	7.29%
	West Cheltenham (JCS)	Residential	21231,21228	90101	7.23%	6.96%	19.58%	24.00%	66.23%	61.75%	6.96%	7.29%
		Employment	91001-91004,21226	91102	7.23%	6.96%	19.58%	24.00%	66.23%	61.75%	6.96%	7.29%
	North West Cheltenham (Safe Guarded)	Residential	21231,21228	94003	6.26%	5.91%	17.59%	21.84%	70.43%	65.01%	5.72%	7.24%
		Employment	91001-91004,21226	95003	6.93%	6.64%	18.96%	23.34%	67.53%	62.75%	6.57%	7.28%
PM	North West Cheltenham (JCS)	Residential	21231,21228	90122	4.47%	5.18%	34.63%	41.39%	52.77%	45.51%	8.13%	7.92%
		Employment	91001-91004,21226	91123	4.47%	5.18%	34.63%	41.39%	52.77%	45.51%	8.13%	7.92%
	West Cheltenham (JCS)	Residential	21231,21228	90101	4.47%	5.18%	34.63%	41.39%	52.77%	45.51%	8.13%	7.92%
		Employment	91001-91004,21226	91102	4.47%	5.18%	34.63%	41.39%	52.77%	45.51%	8.13%	7.92%
	North West Cheltenham (Safe Guarded)	Residential	21231,21228	94003	3.94%	4.69%	29.49%	38.78%	58.10%	47.40%	8.47%	9.13%
		Employment	91001-91004,21226	95003	4.32%	5.03%	33.14%	40.58%	54.32%	46.09%	8.23%	8.29%

Inter-development trips

3.3.14. Given the significant level of residential and employment development proposed within Gloucestershire, the potential for trips to occur between new residential and employment developments is high (particularly for the commuter use class). To ensure that the total level of new development trips was not overestimated, potential linked movements between new residential and new employment zones have been considered. This has been undertaken using the following approach:

1. For each user class, the proportion of trips that stay within the districts of Gloucester, Cheltenham and Tewkesbury were identified;
2. The number of employment and residential destinations in the JCS districts was identified by assuming a split of trips to/from residential and employment sites in each time period. For example, in the AM peak, it was assumed that 80% of trips were from residential/to employment, and the reverse in the PM. The Inter-peak features a 50:50 split.
3. The ratio of development destinations from (2) to total destinations were calculated, for residential and employment zones;
4. The proportion of inter-development trips for (for example) residential to employment trips is therefore the product of (1) and (3).
5. These trips are then distributed across the new development zones based upon the existing number of trips.

Conversion to 24-hour level matrices

3.3.15. All Reference Case matrix forecasts ultimately needed to be prepared at a 24-hour average weekday level and in production/attraction (PA) format for home-based trips, to maintain consistency with the requirements of the VDM setup adopted from the A417 Missing Link model. Non-home-based trips are retained at individual time period level.

3.3.16. Consequently, once development trips matrices were fully developed for individual model time periods, home-based matrices were then converted from origin/destination (OD) matrices from individual model time periods to a 24-hour production/attraction (PA) format, allowing them to be combined with equivalent background growth PA matrices. This conversion process is explained further in section 3.4.

3.4. Background Growth

3.4.1. In addition to accounting for growth in traffic related to specific development sites, background growth has been applied to the base model matrices to account for demand growth in the model not captured by the explicitly modelled development traffic growth, reflecting wider potential land use changes. This section details the process adopted to produce the background growth forecast matrices (at a 24-hour PA level for home-based trips) which are then combined with the development matrices to complete forecast year matrices (prior to constraining back in line with NTEM).

Conversion to 24-hour level matrices

3.4.2. As with the development trip matrices, before calculating and applying background growth, it was first necessary to convert the 2015 base year matrices for individual model time periods, splitting into home-based and non-home based trips and then converting home-based trips to 24-hour average weekday level matrices, in preparation for input into the VDM assignment process. Key steps in this process are as follows:

Split to home-based/Non-home-based

3.4.3. The first step in this process involves splitting out the GCTM car user class matrices (for each trip purpose) into:

- Home-based From-Home (FHB) car trips (PA format);
- Home-based To-Home (THB) car trips (PA format); and
- Non-home based (NHB) car trips (OD format).

3.4.4. To apply this split, factors for each individual model time period were derived from the SWRTM VDM setup process – applying the same values for corresponding disaggregated GCTM model zones. These split factors are applied on an individual model time period basis.

Conversion to 24-hour format

3.4.5. Once each model user class was disaggregated to home-based and non-home-based format for each modelled time period, it was then possible to factor and combine corresponding home-based trip matrices to a 24-hour level. As each model time period represents an average hour assignment for each period, the conversion process is defined as:

24-hour weekday = (AM peak matrix x 3) + (Inter-peak matrix x 6) + (PM peak matrix x 3) + (Off-peak matrix x 12).

3.4.6. The off-peak matrix was produced by factoring the validated inter-peak matrix, using the same factors derived for the A417 Missing Link parent model as displayed in Table 9.

Table 9 – Inter-peak to Off-Peak Conversion Factors by User Class

User Class	IP to OP Factor
Employers Business	0.16
Commuting	0.35
Other	0.26
LGV	0.25
HGV	0.25

3.4.7. Table 10 shows the proportional split of individual journey purposes into the different user class sub-sets as well as the final 24-hour matrix totals.

Table 10 – 2015 Base Matrix Home-Based (from and to) /Non-Home-Based Matrix Proportions

User Class	Matrix	AM Peak		Inter-peak		PM Peak		24 Hour	
		Trips	%	Trips	%	Trips	%	Trips	%
EB	NHB	148,821	40%	238,943	66%	115,957	34%	2,632,840	49%
	FHB	195,607	52%	60,088	17%	54,078	16%	1,380,257	26%
	THB	31,938	8%	61,926	17%	172,040	50%	1,381,561	26%
	Total	376,365	100%	360,956	100%	342,075	100%	5,394,658	100%
Com	THB	35,756	2%	498,368	58%	1,745,943	92%	9,640,062	50%
	FHB	1,935,482	98%	356,092	42%	158,700	8%	9,662,750	50%
	Total	1,971,237	100%	854,459	100%	1,904,643	100%	19,302,812	100%
Other	NHB	459,131	22%	765,546	28%	676,156	22%	9,402,327	23%
	FHB	1,069,180	51%	981,888	36%	1,129,830	36%	15,638,522	39%
	THB	585,045	28%	1,017,971	37%	1,296,184	42%	15,470,279	38%

User Class	Matrix	AM Peak		Inter-peak		PM Peak		24 Hour	
		Trips	%	Trips	%	Trips	%	Trips	%
	Total	2,113,356	100%	2,765,406	100%	3,102,170	100%	40,511,128	100%

Calculation of background growth factors

3.4.8. The background growth for car trips was applied to the base model matrices to account for demand growth in the model not captured by explicitly modelled development traffic growth, reflecting other potential land use changes.

3.4.9. For cars, growth factors from 2015 to each modelled forecast year were extracted from the TEMPro database, which contains version 8 NTEM forecasts. In line with the TAG-recommended approach (Unit M4), these growth factors were adjusted with the latest uncertainty log shared by GCC for each district, using TEMPro's 'alternative planning assumptions' feature. The residual level of the growth was then calculated and applied as 'background' growth.

3.4.10. The background growth calculation for the 2042 forecast year, using the alternate planning assumptions approach is shown in Table 11.

3.4.11. In the case of the Tewkesbury district, the number of households for specific development sites within the uncertainty log was found to exceed the projections between 2015 to 2027, 2034 and 2042 within the NTEM dataset. Thus, the assumptions were adjusted for the JCS as a whole (considering overall background growth across Tewkesbury, Gloucester and Cheltenham). Adjusted growth in uncertainty log considering overall JCS growth as whole is shown in column, 'uncertainty log after JCS (Cheltenham, Gloucester and Tewkesbury) adjustment 2042' of Table 11.

3.4.12. Table 12 shows the growth factors extracted from TEMPro for the default and background growth after adjusting based on the uncertainty log.

Table 11 – TEMPro Alternate Planning Assumptions to Calculate the Background Growth for Year 2015-2042

Area	Name	TEMPro 2015		TEMPro 2042 (A)		Uncertainty Log including WC & NWC (JCS and safeguarded) 2015-2042		Uncertainty Log after JCS (Cheltenham, Gloucester and Tewkesbury) adjustment 2015-2042 (B)		TEMPro Alternate assumption for Background growth 2042 (TEMPro 2042-UL after JCS Adjustment) (A-B)	
		HHs	Jobs	HHs	Jobs	HHs	Jobs	HHs	Jobs	HHs	Jobs
County	Gloucestershire	377,795	496,797	467,087	549,256	32,006	24,355	32,006	24,355	435,081	524,900
Authority	Cheltenham	52,579	72,461	58,087	80,206	5,993	14,479	5,993	14,479	52,094	65,727
Authority	Cotswold	37,541	49,894	48,556	54,829	5,088	1,003	5,088	1,003	43,468	53,825
Authority	Forest of Dean	35,348	34,874	42,707	38,299	0	0	0	0	42,707	38,299
Authority	Gloucester	53,001	72,466	62,648	80,797	3,711	1,156	3,711	1,156	58,937	79,641
Authority	South Gloucestershire	112,647	158,204	143,781	176,552	0	0	0	0	143,781	176,552
Authority	Stroud	49,413	56,688	60,091	61,937	4,249	2,616	4,249	2,616	55,842	59,321
Authority	Tewkesbury	37,267	52,210	51,216	56,635	12,965	5,101	12,965	5,101	38,251	51,535

Table 12 – Comparison Between TEMPro and Background Growth Factors for Year 2015-2042

Area Description		HB Work TEMPro 2042		HB Work Background Growth 2042		HB Employers Business TEMPro 2042		HB Employers Business Background Growth 2042		HB Education TEMPro 2042		HB Education Background Growth 2042	
Level	Name	Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction
County	Gloucestershire	1.1303	1.1212	1.0543	1.0741	1.1716	1.1614	1.0921	1.1115	1.1444	1.1296	1.0710	1.0828
Authority	Cheltenham	1.0358	1.1246	0.9274	1.0160	1.0770	1.1688	0.9642	1.0559	1.0482	1.1064	0.9385	0.9996
Authority	Cotswold	1.1220	1.1183	1.0044	1.0978	1.1629	1.1605	1.0410	1.1393	1.1439	1.1237	1.0240	1.1031
Authority	Forest of Dean	1.0839	1.1179	1.0839	1.1179	1.1233	1.1598	1.1233	1.1598	1.1039	1.1279	1.1039	1.1279
Authority	Gloucester	1.1300	1.1337	1.0824	1.0162	1.1720	1.1786	1.1227	1.0564	1.1307	1.1374	1.0830	1.0195
Authority	South Gloucestershire	1.1597	1.1259	1.1597	1.1259	1.1994	1.1613	1.1994	1.1613	1.1806	1.1361	1.1806	1.1361
Authority	Stroud	1.1077	1.1111	1.0293	1.0642	1.1444	1.1525	1.0635	1.1038	1.1125	1.1356	1.0338	1.0876
Authority	Tewkesbury	1.2436	1.1029	0.9049	1.0130	1.2893	1.1432	0.9382	1.0500	1.2568	1.1370	0.9145	1.0443

3.5. Combining of Matrices and Constraining

3.5.1. The development-only and background growth factored matrices were combined to create complete forecast matrices for all time periods and forecast years.

3.5.2. Following TAG Unit M4, the combined matrices were then compared with NTEM values to ensure that growth in Gloucestershire was generally consistent with the NTEM projections. Growth for all trips to/from Gloucestershire zones were constrained in line with NTEM growth projections for the Gloucestershire region to ensure that traffic growth in the model is of a suitable level for estimating the impact of future year schemes, but with specific development trips fixed in line with the respective trip rates.

3.5.3. The constraining process adopted is shown in flowchart as shown in Figure 3-3. Where HB refers to Home-based 24-hour PA demand and NHB refers to Non-Home-Based OD demand at peak period level.

3.5.4. The matrices are production constrained for home-based trips and doubly constrained for non-home-based trips. Matrix totals for internal-internal (within Gloucestershire) and all internal-external movements to/from Gloucestershire pre- and post-constraining are presented in Table 13.

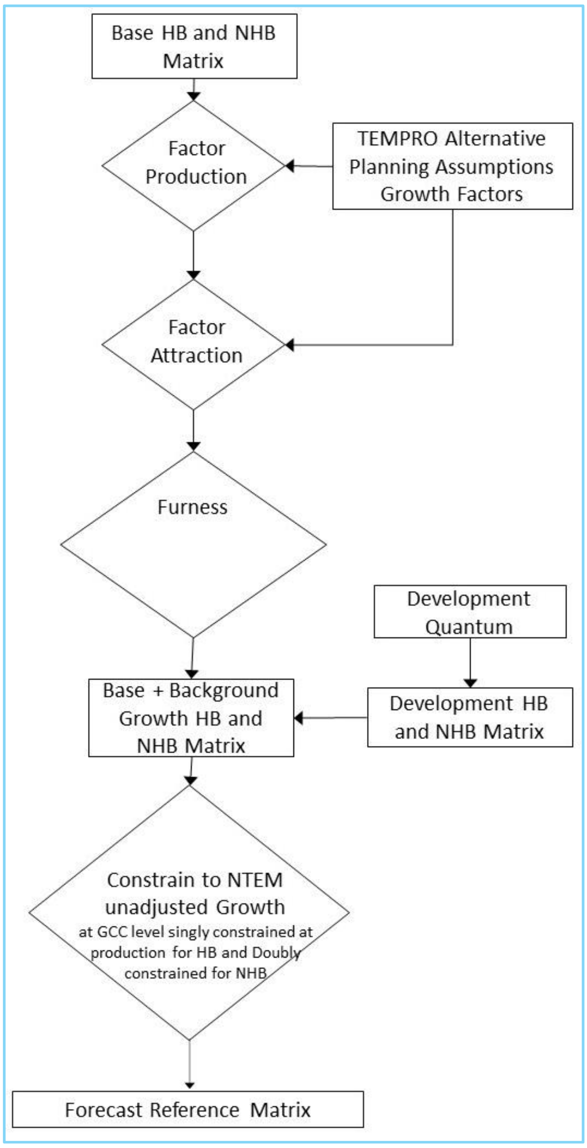


Figure 3-3 – M5 J10 Methodology for scenario Q reference demand Constraining

Table 13 – Comparison of Car Trip Matrices Totals Pre-and Post-Constraining

User Class	Scale	Time Period	2027			2034			2042		
			Pre	Post	% diff.	Pre	Post	% diff.	Pre	Post	% diff.
Home-based EB	Within Gloucs	24Hr	17,736	15,812	-10.8%	18,537	16,459	-11.2%	18,903	16,933	-10.4%
	All trips to/from Gloucs	24Hr	36,063	33,223	-7.9%	37,341	34,291	-8.2%	38,160	35,242	-7.6%
Home-based Work	Within Gloucs	24Hr	121,456	110,071	-9.4%	128,460	114,013	-11.2%	132,597	116,754	-11.9%
	All trips to/from Gloucs	24Hr	194,861	180,240	-7.5%	203,979	185,516	-9.1%	209,851	189,614	-9.6%
Home-based Other	Within Gloucs	24Hr	279,286	264,412	-5.3%	293,063	279,020	-4.8%	303,850	291,454	-4.1%
	All trips to/from Gloucs	24Hr	370,299	352,843	-4.7%	388,710	372,188	-4.3%	403,555	388,809	-3.7%
Non-home based EB	Within Gloucs	AM	1,000	869	-13.1%	1,064	902	-15.2%	1,106	925	-16.4%
		IP	2,211	1,914	-13.4%	2,322	1,930	-16.9%	2,386	2,020	-15.3%
		PM	896	754	-15.8%	955	841	-11.9%	985	802	-18.6%
	All trips to/from Gloucs	AM	1,899	1,720	-9.4%	1,978	1,763	-10.9%	2,031	1,796	-11.6%
		IP	3,838	3,452	-10.1%	3,975	3,601	-9.4%	4,062	3,609	-11.2%
		PM	1,672	1,486	-11.1%	1,745	1,603	-8.1%	1,784	1,553	-12.9%
Non-home based other	Within Gloucs	AM	4,404	4,082	-7.3%	4,810	4,282	-11.0%	5,259	4,457	-15.3%
		IP	9,545	8,691	-8.9%	10,077	9,094	-9.8%	10,672	9,439	-11.6%
		PM	6,172	5,530	-10.4%	6,620	5,804	-12.3%	7,070	6,042	-14.5%
	All trips to/from Gloucs	AM	6,617	6,234	-5.8%	7,079	6,462	-8.7%	7,554	6,644	-12.0%
		IP	13,594	12,620	-7.2%	14,230	13,140	-7.7%	14,884	13,554	-8.9%
		PM	9,563	8,839	-7.6%	10,089	9,188	-8.9%	10,596	9,467	-10.7%

3.6. Growth in Goods Vehicle trips

3.6.1. Goods vehicle growth is not available within NTEM and is instead derived from the DfT National Road Traffic Projections 2022[1] (NRTP22) as per TAG. Within Gloucestershire and surrounding areas, a local adjustment has been applied based on the proportional difference between the local district and the South West for car trips in NTEM. Growth factors applied for the different forecast years are provided in Table 14.

Table 14 – LGV and HGV User Class Growth Factors by District and Forecast Year

	2027		2034		2042	
Area	LGV	HGV	LGV	HGV	LGV	HGV
Vale of the White Horse	1.316	1.095	1.406	1.155	1.582	1.222
Bristol, City of	1.255	1.046	1.311	1.075	1.465	1.106
Cheltenham	1.233	1.028	1.275	1.046	1.407	1.062
Cotswold	1.260	1.051	1.321	1.084	1.476	1.114
Forest of Dean	1.240	1.034	1.292	1.060	1.436	1.084
Gloucester	1.260	1.050	1.314	1.078	1.458	1.101
South Gloucestershire	1.251	1.043	1.310	1.075	1.465	1.106
Stroud	1.247	1.040	1.300	1.067	1.443	1.089
Tewkesbury	1.276	1.064	1.350	1.107	1.519	1.146
Swindon	1.247	1.040	1.301	1.068	1.442	1.088
Wiltshire	1.244	1.037	1.288	1.057	1.419	1.071
Malvern Hills	1.294	1.054	1.375	1.094	1.529	1.128
Wychavon	1.302	1.060	1.388	1.104	1.554	1.146
External	1.251	1.043	1.303	1.069	1.447	1.092

3.7. Reference Case Growth

3.7.1. The finalised forecast matrix totals and the relative growth compared to the 2015 base year are presented in Table 15 for internal trips within Gloucestershire zones and Table 16 for trips across the whole model area. The tables demonstrate that forecast percentage growth within Gloucestershire is generally in line with the wider model area as would be expected.

3.7.2. As a final check on the suitability of the matrices, the overall growth in the trip matrices for car trips at a 24-hr level is compared against the standard projections from NTEM 8 for the South West and Great Britain. Table 17 shows that the overall model growth for the model lies close to the percentage growth for the South West region projection, demonstrating a sensible level of growth has been applied across the different trip purposes.

[1] https://www.gov.uk/government/publications/national-road-traffic-projections

Table 15 – Forecast Growth within Gloucestershire – Car Trips

Demand Segment	Time Period	2015	2027		2034		2042	
		Base	Diff	%	Diff	%	Diff	%
Home Based EB	24-hr	30,029	3,193	10.6%	4,261	14.2%	5,213	17.4%
Home Based Work	24-hr	167,061	13,179	7.9%	18,454	11.0%	22,552	13.5%
Home Based Other	24-hr	313,587	39,256	12.5%	58,601	18.7%	75,221	24.0%
Non-Home Based EB	AM	1,617	103	6.4%	146	9.1%	179	11.1%
	IP	3,232	219	6.8%	369	11.4%	377	11.7%
	PM	1,400	86	6.1%	203	14.5%	153	10.9%
Non-Home Based Other	AM	5,704	530	9.3%	759	13.3%	941	16.5%
	IP	11,504	1,116	9.7%	1,637	14.2%	2,050	17.8%
	PM	8,090	749	9.3%	1,098	13.6%	1,377	17.0%

Table 16 – Forecast Overall Growth – Car Trips

Demand Segment	Time Period	2015	2027		2034		2042	
		Base	abs. diff	%diff	abs. diff	%diff	abs. diff	%diff
HB EB	24-hr	1,380,909	139,936	10.1%	183,944	13.3%	223,932	16.2%
HB Work	24-hr	9,651,406	743,064	7.7%	1,011,244	10.5%	1,213,268	12.6%
HB Other	24-hr	15,554,400	1,823,796	11.7%	2,691,695	17.3%	3,396,420	21.8%
NHB EB	AM	148,821	12,907	8.7%	17,483	11.7%	21,033	14.1%
	IP	238,943	20,679	8.7%	28,017	11.7%	33,710	14.1%
	PM	115,957	10,058	8.7%	13,624	11.7%	16,392	14.1%
NHB Other	AM	459,131	46,637	10.2%	66,957	14.6%	83,257	18.1%
	IP	765,546	79,947	10.4%	114,418	14.9%	142,774	18.6%
	PM	676,156	70,947	10.5%	101,299	15.0%	126,371	18.7%

Table 17 – Overall Matrix Growth Compared Against NTEM 8 Projections – Car Trips

Trip Purpose	2027			2034			2042		
	Model Ref Case	NTEM 8 (Avg Weekday)		Model Ref Case	NTEM 8 (Avg Weekday)		Model Ref Case	NTEM 8 (Avg Weekday)	
		SW	GB		SW	GB		SW	GB
HBEB	10.1%	10.1%	10.2%	13.3%	13.3%	13.5%	16.2%	16.2%	16.7%
HBW	7.7%	7.7%	7.7%	10.5%	10.5%	10.5%	12.6%	12.6%	12.9%
HBO	11.7%	11.5%	9.7%	17.3%	16.9%	13.9%	21.8%	21.1%	17.4%
NHBEB	8.7%	8.7%	8.4%	11.7%	11.7%	11.4%	14.1%	14.1%	13.9%
NHBO	10.3%	10.4%	9.1%	14.8%	14.8%	12.6%	18.5%	18.4%	15.7%

3.8. Scenario P Methodology

3.8.1. Scenario P demand for various forecast years was developed by taking the scenario Q VDM output demand for respective year as starting point and removed a proportion of North West Cheltenham and West Cheltenham JCS and Safeguarded development trips (dependent development) from the respective development zones. As scenario Q, which represents the most congested scenario, will already be run through VDM process, therefore, scenario P is not to be run through the VDM process again. This will help in better understanding of the differences in network performance due to changes in demand and /or scheme without interference of the VDM elements which could be difficult to explain.

3.8.2. Table 18 provides the development quantum and the associated reduction factor that was applied on Scenario Q VDM matrices to create Scenario P demand.

Table 18 – Scenario P development Quantum and Associated Reduction Factor

Development	Description	Deadweight Component	Dependent Component	Total Development Scenario Q 2042	% Reduction of Trip for Scenario P
North West Cheltenham (JCS)	Dwellings	973	3,312	4,285	77%
	Employment floor space (Sqm)	9,853	26,147	36,000	73%
West Cheltenham Golden Valley Development (JCS)	Dwellings	225	2,146	2,371	91%
	Employment floor space (Sqm)	21,245	189,042	210,287	90%
North West Cheltenham (Safe Guarded)	Dwellings	513	1,745	2,258	77%
	Employment floor space (Sqm)	27,200	80,800	108,000	75%

4. Forecast Network Development

4.1. Overview

4.1.1. This chapter summarises the changes made to the base highway networks to produce the core scenario forecast networks for each of the future years required. This starts with the development of the scenario Q and P, followed by the creation of the scenarios R and S.

4.1.2. This chapter also details the adopted generalised cost parameters for the purposes of model assignment.

4.2. Scenario Q and P (Without Scheme)

4.2.1. As outlined in Chapter 2 of this report, the scenarios Q and P comprise the validated base model network with the addition of any highway network changes which are considered as either 'near certain' or 'more than likely' to proceed by the modelled forecast years of 2027, 2034 and 2042. The transport scheme for this assessment is defined as M5 J10 DCO Scheme which includes the all movement M5 J10; Dualling of A4019; and new link road from A4019 to the West Cheltenham Development/Cyber park.

4.2.2. The Coombe Hill junction improvements scheme which is being progressed through a separate planning route has been included in both the Scenarios P and Q networks.

Core scenario highway schemes

4.2.3. The uncertainty log provided by GCC includes schemes being promoted by the County Council and by National Highways; with some schemes located throughout the wider model, in the 'buffer' coding area of the GCTM. Recognising the base model of March 2015, the uncertainty log also includes schemes completed since that date.

4.2.4. The schemes have been included within all forecast years, as all schemes that met the threshold to be considered at least 'more than likely' and were expected to be open by 2027, the first forecast year. Many of the schemes (particularly those on the Strategic Road Network) were already included in the A417 Missing Link Stage 2 model, and as a result, the scheme coding used for that model was adopted or adapted in the DM scenario of GCTM Version 2.3 network where possible. For local road schemes, relevant details were provided by GCC or sourced from publicly available consultation documents.

4.2.5. Table 19 provides the list of schemes that were added to the 2015 base year network to develop scenario Q (DM) network. It also has description of schemes and their locations i.e., in buffer or simulation network. Figure 4-1 shows the locations of all highway schemes included in the DM networks, their uncertainty status as well as scheme references provided in Appendix B.

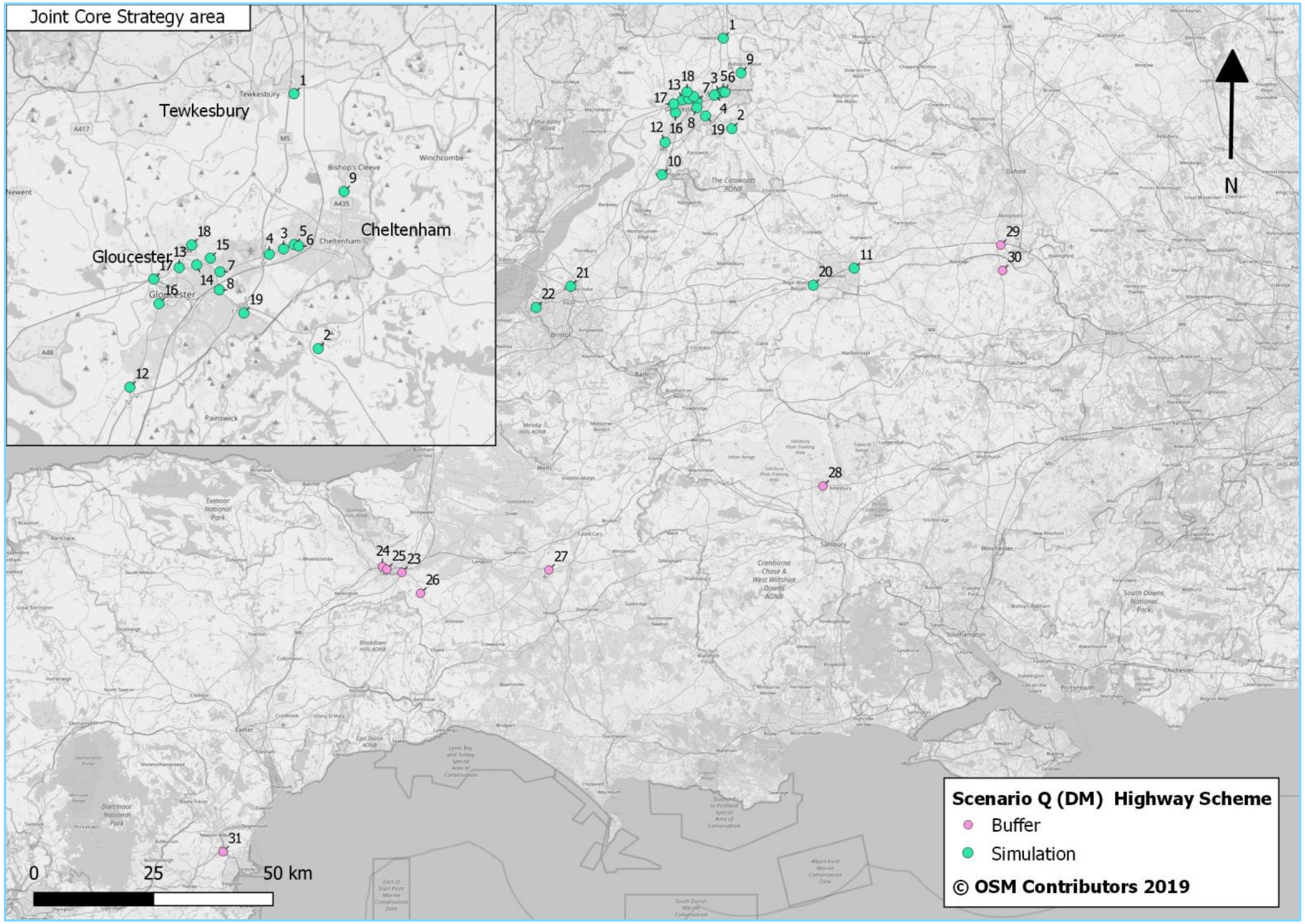


Figure 4-1 – Scenario Q (Do Minimum) Highway scheme location

Table 19 – List of Do Minimum Highway Schemes

Ref. No	Scheme	Network Region	Change to Network
1	Fiddington development mitigation measures	Simulation	Widening of M5 J9, including the northbound off-slip and Shannon Way junction to the west
2	A417 Missing Link	Simulation	Upgrade of A417 to dual carriageway between Brockworth bypass and Cowley roundabout.
3	West of Cheltenham (WoC) A40 Phase 1 - Arle Court	Simulation	Additional lanes and bus lane at Arle Court roundabout.
4	WoC A40 Phase 2 - M5 J11	Simulation	Additional lanes around eastern access to M5 J11.
5	WoC A40 Phase 3 - Arle Court to Benhall	Simulation	Eastbound carriageway widening.
6	WoC A40 Phase 4 - Benhall to Griffiths Ave	Simulation	Eastbound carriageway widening.
7	Elmbridge Transport Scheme and A40 Elmbridge Court, Gloucester	Simulation	Junction upgrade and widening of approaches.
8	A417/A40 Barnwood Link	Simulation	Addition of signalised junction in link.
9	A435/Hyde Lane/Southam Lane Signalised Junction improvements	Simulation	Capacity improvements at junction.
10	A419 corridor improvements, Stonehouse	Simulation	Junction improvements and carriageway widening.
11	A419 White Hart junction improvement, Swindon	Simulation	Upgrade of slip roads.
12	A38 Cross Key roundabout	Simulation	Additional lanes on approach.
13	A40 Longford roundabout junction improvement, Gloucester	Simulation	Widening of approaches.
14	A40 access roundabout addition, Innsworth	Simulation	New roundabout for access to Innsworth Lane.
15	Innsworth Development Access Improvement	Simulation	Capacity improvements to Innsworth Lane.
16	A430 Llanthony Rd and St Ann Way (Southwest bypass) improvement, Gloucester	Simulation	Widening of A430
17	A40 Over Roundabout improvement (phase 2), Gloucester	Simulation	Capacity improvements at roundabout.
18	A38 Tewkesbury Road (Twigworth)	Simulation	Addition of roundabout for development access.
19	Perrybrook (Brockworth) development	Simulation	Addition of four access junctions.
20	M4 J15-17	Simulation	Smart motorway upgrades (widening).
21	A38, M5 J16 to Aztec West, Almondsbury	Simulation	Capacity improvements at junctions along A38 Aztec West corridor.
22	M49 Avonmouth Junction	Simulation	Addition of junction.
23	M5 J25	Buffer	Alteration in approach to J25 (Taunton).
24	Staplegrove, Taunton	Buffer	Staplegrove development access link.

Ref. No	Scheme	Network Region	Change to Network
25	Northern Inner Distribution Road (NIDR), Taunton	Buffer	Addition of new road.
26	A358 Taunton to Southfields	Buffer	Upgrade to dual carriageway
27	A303 Sparkford - Ilchester dualling	Buffer	Upgrade to dual carriageway
28	A303 Amesbury to Berwick Down	Buffer	Widening and re-alignment.
29	A34 Milton Interchange Improvement	Buffer	Junction re-alignment and widening of approaches
30	A34 Chilton Interchange Improvement	Buffer	Addition of north-facing slips.
31	A380 South Devon Highway (Kingskerswell Bypass)	Buffer	Addition of new road.

Development zone access points

4.2.6. Chapter 3 provides details of the various development sites included within the forecast assignments as specific zones. Each of these zones therefore needed to be included in the forecast network files. The majority of smaller sites, zone access points were coded using “spanning connectors” – loading trips along the length of appropriate links (as is the case with the majority of base model zones) rather than coding specific junction access points with “spigot connectors”.

4.2.7. Figure 4-2 shows the development zone access points for North west Cheltenham and West Cheltenham zones.

Fixed speed network

4.2.8. As is standard practice with the National Highways Regional Traffic Models, model speed parameters in the peripheral fixed-speed area of the network were reduced, based upon the 2022 National Road Traffic Projections[2] (NRTP), which set out forecast changes in average speed across regions of England and Wales. By adjusting the speed parameters in the fixed area of the network, the overall slowing of the road network in future years is simulated more efficiently.

[2] https://www.gov.uk/government/publications/national-road-traffic-projections

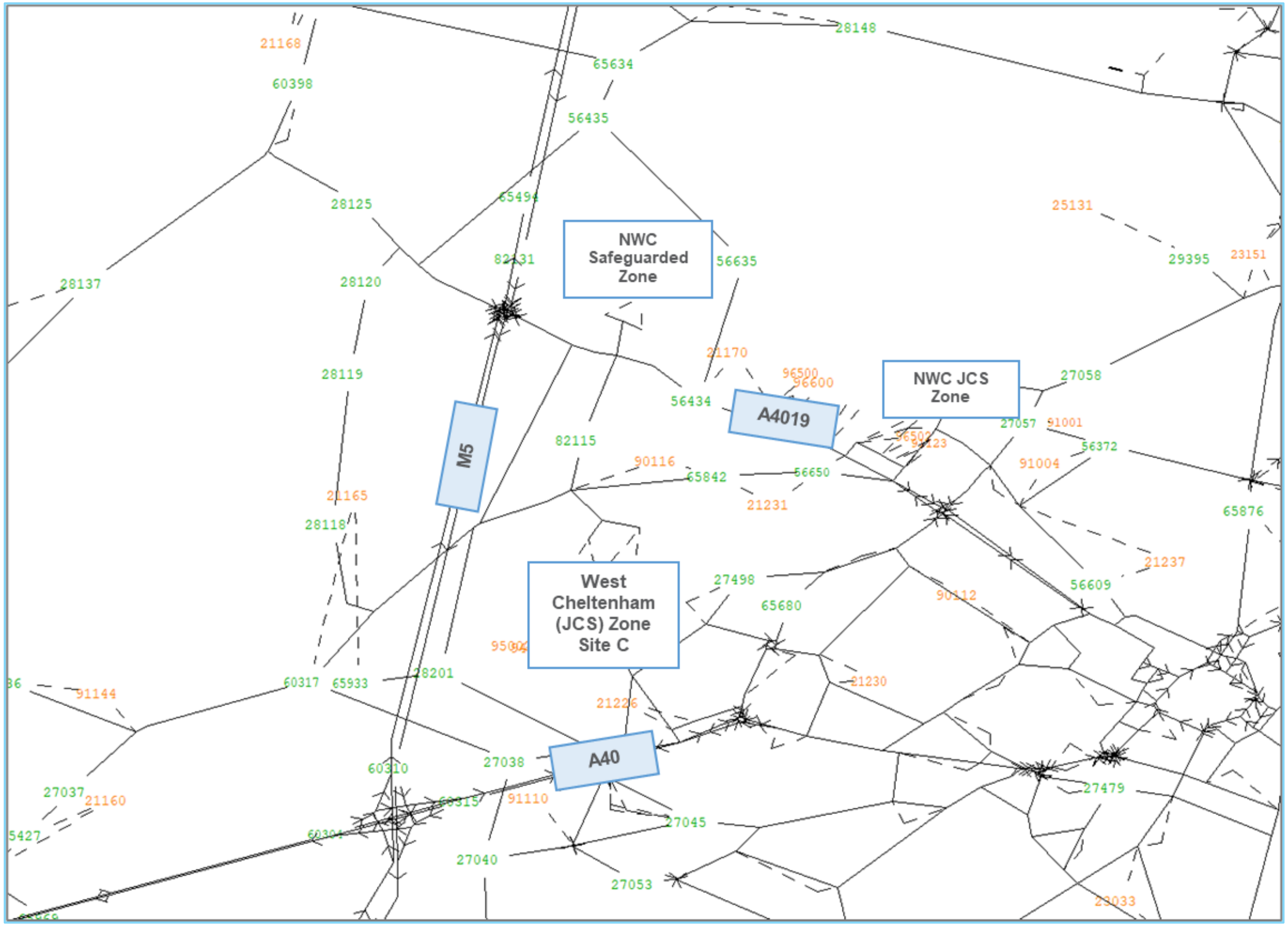


Figure 4-2 – Scenario Q (Do Minimum) Development access point for NWC and WC zones

4.3. Scenario R and S (With Scheme)

4.3.1. The Scheme for this assessment under Scenarios R and S are defined as M5 J10 DCO Scheme which includes the all movement M5 J10; Dualling of A4019; and new link road from A4019 to the West Cheltenham Development/Cyber park. Following the options consultation in autumn 2020, GCC decided to accelerate the A38/A4019 Junction Improvements at Coombe Hill as a separate scheme. This is to provide a more resilient local road network in advance of the proposed M5 Junction 10 Improvements Scheme works commencing. The Coombe Hill junction improvements scheme which is being progressed through a separate planning route has been included in both the Scenarios R and S networks.

4.3.2. The improvement related schemes were coded into scenario Q networks, the updated networks were used to run assignments for scenarios R and S. Checks on the future networks were undertaken to ensure that the schemes were accurately represented. The future year scheme alignments were provided in a Geographic Information System (GIS) format (as shown in Figure 4-3).

4.3.3. Detailed lane allocations relating to the new M5 J10 arrangements were utilised from DR 2.3 design release. These drawings are presented in Appendix C for reference. Consequently, initial assignments were checked, and signal timings were optimised to ensure the most efficient operation practicable at the junction.

4.3.4. An area of interest as shown in Figure 4-4 based on node delays in base network was identified and a set of signals were selected to be optimised. These traffic signals were optimised across all scenarios and for variable demand run it was optimised using reference case demand assignment after first loop of VDM.

4.3.5. In addition to the above, flow difference plots between the DM and DS networks (using fixed demand assignments initially) were analysed to assess the changes as a result of the scheme.

Figure 4-3 – Scenario R-S (Do Something) aligned network

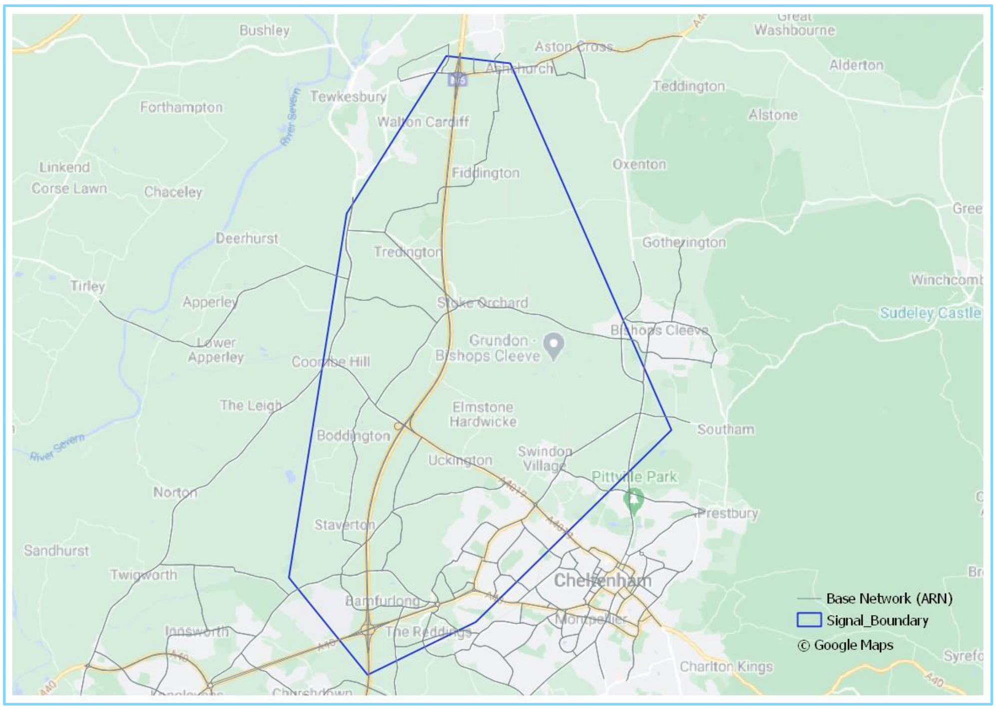


Figure 4-4 – Selected area for Signal optimisation

4.4. Generalised Cost Parameters

4.4.1. The generalised cost of travel is based on a combination of factors that drivers consider when choosing the route of their journey, primarily time and distance. Generalised cost parameters are used in SATURN to represent the travellers' value of time by pence per minute (PPM) and distance by pence per kilometre (PPK). The parameters are set individually for the different model user classes. Where a choice of route exists (as in most cases), these values are used to determine which available route has a lower 'cost' to the traveller.

4.4.2. The TAG Databook provides monetary values of time (to derive PPM) and fuel and non-fuel vehicle operating costs

4.4.3. The GCTM Version 2.3 adopted PPM and PPK values derived from version TAG Databook V1.20.2 (released January 2023. The parameters adopted are presented in Table 20.

4.4.4. It should be noted that, as with the base model parameters, User Class 5 (HGVs) includes a multiplier (2.3) for consistency with RTM technical guidance and to reflect the fact that route choice for HGVs is typically based on an operator's Value of Time (VoT) rather than a driver's VoT.

4.4.5. For consistency with the M5 J9 modelling, a default speed of 54kph was considered to calculate the pence per kilometre values.

Table 20 – Future Highway Generalised Cost Parameters

Year	UC	Description	PPM (pence per minute)			PPK (pence per kilometre)		
			AM	IP	PM	AM	IP	PM
2027	1	Car (Business)	33.44	34.27	33.93	11.78	11.78	11.78
	2	Car (Commuter)	22.43	22.79	22.51	6.10	6.10	6.10
	3	Car (Other)	15.47	16.48	16.20	6.10	6.10	6.10
	4	LGV	24.24	24.24	24.24	13.72	13.72	13.72
	5	HGV	55.52	55.52	55.52	42.87	42.87	42.87
2034	1	Car (Business)	37.35	38.28	37.89	10.16	10.16	10.16
	2	Car (Commuter)	25.05	25.46	25.14	5.29	5.29	5.29
	3	Car (Other)	17.28	18.41	18.10	5.29	5.29	5.29
	4	LGV	27.07	27.07	27.07	12.83	12.83	12.83
	5	HGV	62.01	62.01	62.01	41.11	41.11	41.11
2042	1	Car (Business)	42.20	43.25	42.81	9.02	9.02	9.02
	2	Car (Commuter)	28.30	28.76	28.40	4.51	4.51	4.51
	3	Car (Other)	19.53	20.80	20.45	4.51	4.51	4.51
	4	LGV	30.58	30.58	30.58	11.13	11.13	11.13
	5	HGV	70.06	70.06	70.06	39.15	39.15	39.15

5. Variable Demand Forecast

5.1. Overview

5.1.1. This chapter details the setup and the results of the Variable Demand Model (VDM) process applied in developing the M5 J10 Improvement Transport Scheme assignments.

5.1.2. A road improvement scheme which provides extra road network capacity, reduced journey times and costs, can lead to traffic levels changing through redistribution, trip generation, modal switch and changes in macro time period choice. In the same way, if there is a shortage of capacity in the future (as modelled in the Do Minimum scenario) traffic growth can be suppressed. To take these impacts into account, the VDM was developed to estimate the future year traffic matrices for the most congested scenario (Q).

5.1.3. The VDM model used for PCF Stage 3 of the M5 J10 Improvement is derived from the A417 Missing Link Stage 2 scheme setup and is therefore based on work carried out during the development of the SWRTM model. However, because of the increased level of zone and network detail within Gloucestershire and the scheme study area, a scheme-specific setup was adopted.

5.1.4. VDM for the GCTM Version 2.3 model was undertaken using the DfT's Dynamic Integrated Assignment and Demand Modelling (DIADEM) software (version 7.0).

5.2. VDM Setup

5.2.1. As referenced in Chapter 3, the VDM modelling process for PCF Stage 3 uses trip demand matrices in production/attraction (P/A) format, rather than origin-destination (O-D) format as required in the traffic assignments. This is to retain the linkage between outbound and return journeys for home-based trips. Using this format, demand response calculations take into account both legs of a home-based journey as part of the calculation of an overall resulting demand response.

5.2.2. The output from these DIADEM runs are used to calculate incremental changes between the base year and the forecast year, which are then applied to the Reference Case matrices.

5.2.3. Chapter 3 provides a description of the derivation of the Reference Case forecast matrices, which are input to the VDM model in the creation of future year scenarios. The Reference Case forecast matrices reflect those changes in demand from the 2015 base year which are attributable to demographic and socio-economic changes but take no account of changes in network travel costs from the base year model.

5.2.4. The VDM model process then creates forecast assignments using the Reference Case matrices to generate initial travel costs which are pivoted off the base year assignment. DIADEM then undertakes a number of iterations (involving the VDM model and the highway assignment model) to find an equilibrium balance between demand and supply. Using this methodology, forecast matrices are created accounting for:

- Transport interventions between the base year and forecast;
- Increases in the value of time resulting from real increases in income;
- Increases in the levels of congestion arising from increased car usage; and
- Increases in fuel efficiency that makes car travel cheaper.

5.2.5. The process is run only for scenario Q which is the worst case (highest amount of demand and without the proposed additional network capacity) scenario. Only scenario Q was run through VDM as explained in chapter 3. Scenarios P and S demand was derived from VDM output of scenario Q. This results in same levels of demand between each of the forecast scenarios i.e., between P and S, between Q and R.

5.2.6. Full setup of the VDM process is detailed with the PCF Stage 3 Transport Model Package document (GCCM5J10-ATK-HTA-ZZ-RP-TR-000003). This confirms the VDM parameters which were adopted, and details results of the realism testing conducted on the base year traffic model prior to traffic forecasting to ensure that the PCF Stage 3 traffic model responds to changes in travel costs in a realistic way.

5.3. DIADEM Convergence

5.3.1. As detailed in the previous section, the VDM process is iterative, modifying the model demand matrices between SATURN assignments until a balance is achieved between demand and the capacity of the road network. The success in achieving this balance of equilibrium is defined using convergence criteria such as the demand/supply gap, commonly termed '%Gap'.

5.3.2. The objective of this process is to achieve well converged VDM models with realistic demand responses, thereby improving the accuracy of the scheme benefit calculations (e.g., in TUBA). TAG Unit M2.1 recommends, where possible, to aim to achieve an overall demand/supply gap of less than 0.1%. If this criterion cannot be met, then a demand/supply gap of no greater than 0.2% is recommended. The National Highways RTMs utilised a criterion of a %Gap of less than 0.1% for the fully modelled area and 0.2% for the sub-area. The same criteria have been adopted for the GCTM Version 2.3.

5.3.3. The DIADEM convergence results for all forecast scenario assignments are shown in Table 21. The results confirm that all assignments achieve the desired criteria at both the fully modelled area and subset area level.

Table 21 – DIADEM Convergence Statistics for Scenario Q

Year	Final Loop	%Gap	
		Fully modelled area	Subset Area
2027	7	0.03%	0.10%
2034	7	0.08%	0.14%
2042	8	0.08%	0.11%

5.4. Highway Assignment Model Convergence

5.4.1. Convergence of the post-VDM highway assignment model is important to providing consistent and robust model results. Model convergence is key to robust appraisal of Transport Economic Efficiency (TEE). Before the results of traffic assignments are used to inform economic appraisal, the stability of the model assignments must be confirmed in order to demonstrate the model provides stable and consistent results. Guidance on the degree of model convergence is provided in TAG Unit M3.1 as set out in Table 22.

Table 22 – Summary of Minimum Highway Assignment Convergence Requirements

Measure of Convergence	Acceptable Values
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P)<1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2) <1%	Four consecutive iterations greater than 98%

5.4.2. The GCTM Version 2.3 uses the same convergence parameters as the A417 Missing Link Stage 2 model and adopts a tighter set of criteria than specified by TAG, with the SATURN ISTOP parameter (Percentage differences between the target demand flows on the final loop and those on the previous loop) increased from the default 98% to 100%.

5.4.3. Table 25 to Table 27 in Chapter 6 show the level of convergence achieved by the Stage 3 model for each modelled scenario by time period and forecast year. It also includes the base model convergence.

5.4.4. Overall, the results indicate that the model achieves a good level of convergence that complies with TAG.

5.5. Change in highway trip matrix totals

5.5.1. The impact of the VDM process compared against the Reference Case matrices in terms of the growth in total trips versus the base model (on which realism was done and fitting on factor was calculated) are set out in Table 23.

Table 23 – Pre vs Post VDM Trip Matrix Growth for Full Model– Including Intra-Zonal Trips

Year	Scenario	AM Peak		Inter-peak		PM Peak	
		Trips	% Diff	Trips	% Diff	Trips	% Diff
2015	Base	5,405,767		4,884,778		6,057,249	
2027	Reference	6,008,890	11.16%	5,465,430	11.89%	6,731,580	11.13%
	Post VDM	6,010,801	11.19%	5,464,031	11.86%	6,726,883	11.06%
2034	Reference	6,230,202	15.25%	5,686,487	16.41%	6,993,644	15.46%
	Post VDM	6,242,130	15.47%	5,685,644	16.40%	7,000,080	15.57%
2042	Reference	6,472,680	19.74%	5,927,466	21.35%	7,257,040	19.81%
	Post VDM	6,496,576	20.18%	5,927,678	21.35%	7,279,099	20.17%

5.5.2. The above table demonstrates how the VDM process impacts the level of trips compared to the reference case in response to changes in income and fuel efficiency. The results show that impact of the VDM is generally modest. The VDM process invariably leads to small amount change is demand between -0.07% to 0.37%.

5.6. Trip Length Distribution

5.6.1. The impact of the VDM process in terms of the trip length distribution has also been considered in terms of the changes between the scenario Q Reference Case assignment and post-VDM assignment. This is presented in Figure 5-1 to Figure 5-3.

5.6.2. The figures show a consistent pattern for all peak periods, with a general increase in the level of long-distance trips (longer than 15km) and a reduction in shorter distance movements (less than 10km). This is a typical and expected impact of the VDM process, in response to reducing cost of car travel in real terms as a result of factors such as increased fuel efficiency and average income levels.

5.6.3. Analysing the change in trip length distribution demonstrates that across the forecast years, the proportion of longer distance trips increases for all forecast years in comparison to the base year scenario, gradually increases up to 2042 which again illustrate the response to economic factors.

5.6.4. Importantly, the proportions are highly consistent between the AM, IP and PM with only minor changes observed as would be expected given the overall scale of the traffic model.

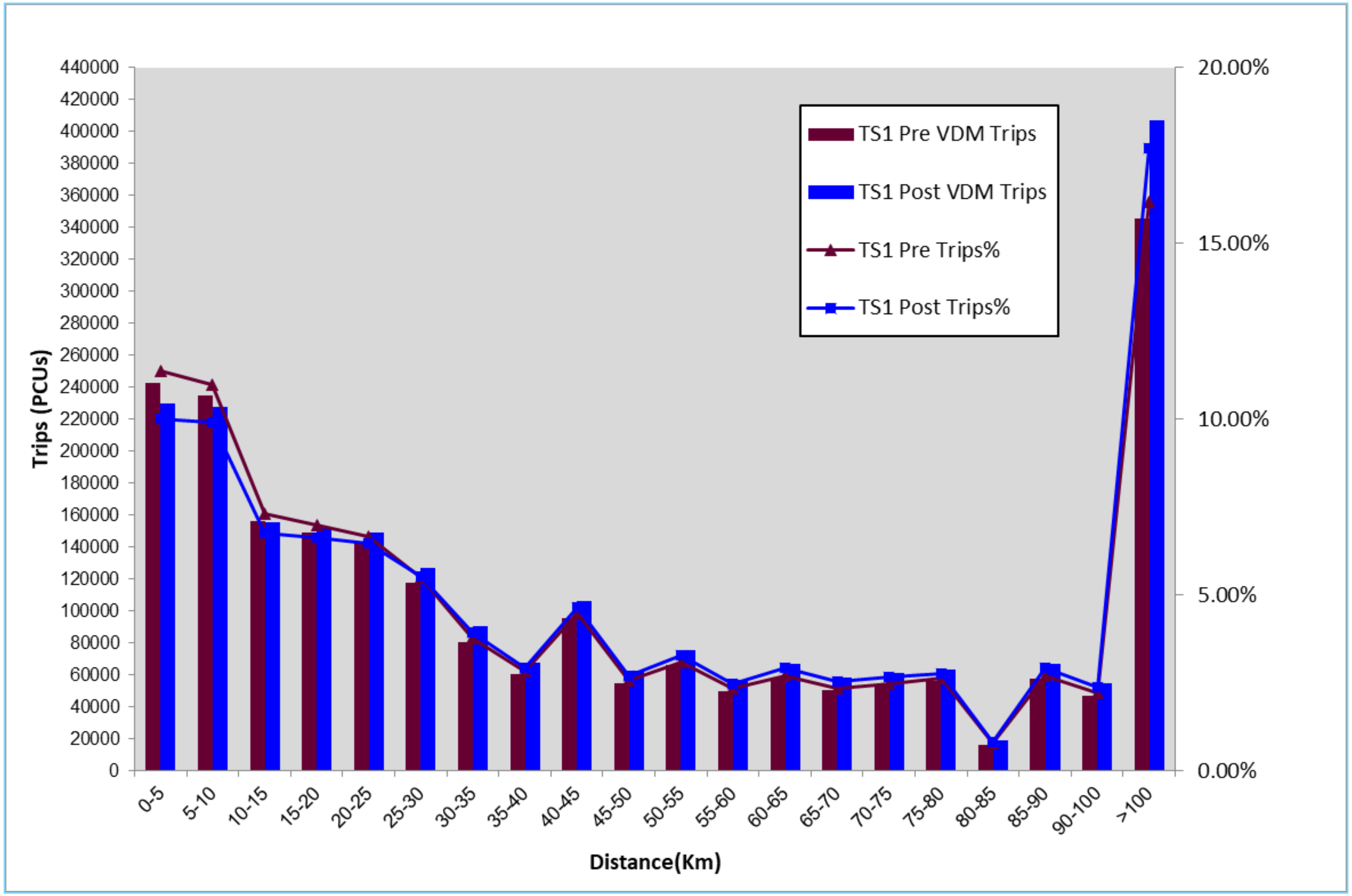


Figure 5-1 – Trip length distribution for 2042 AM Scenario Q pre vs. post VDM

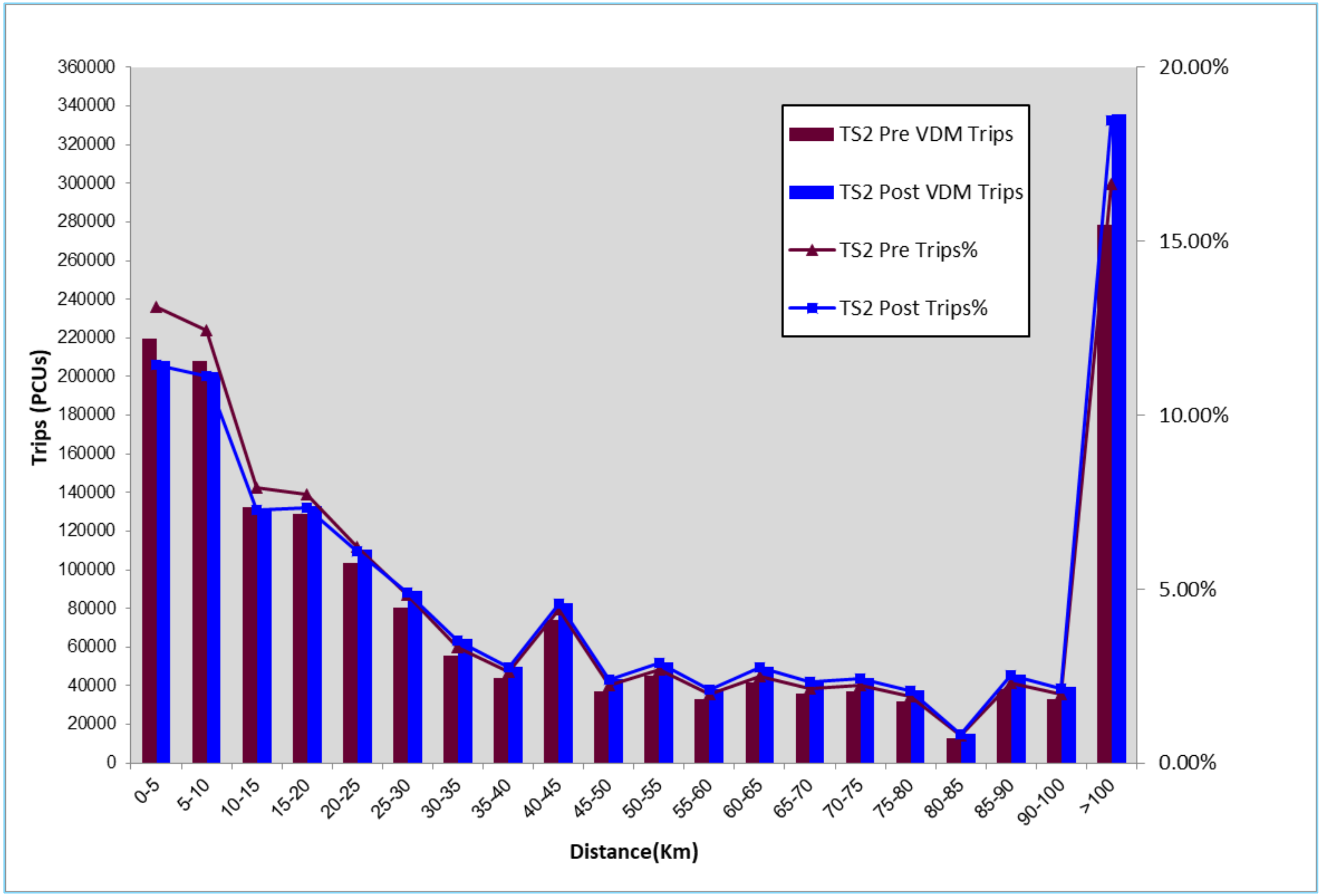


Figure 5-2 – Trip length distribution for 2042 IP Scenario Q pre vs. post VDM

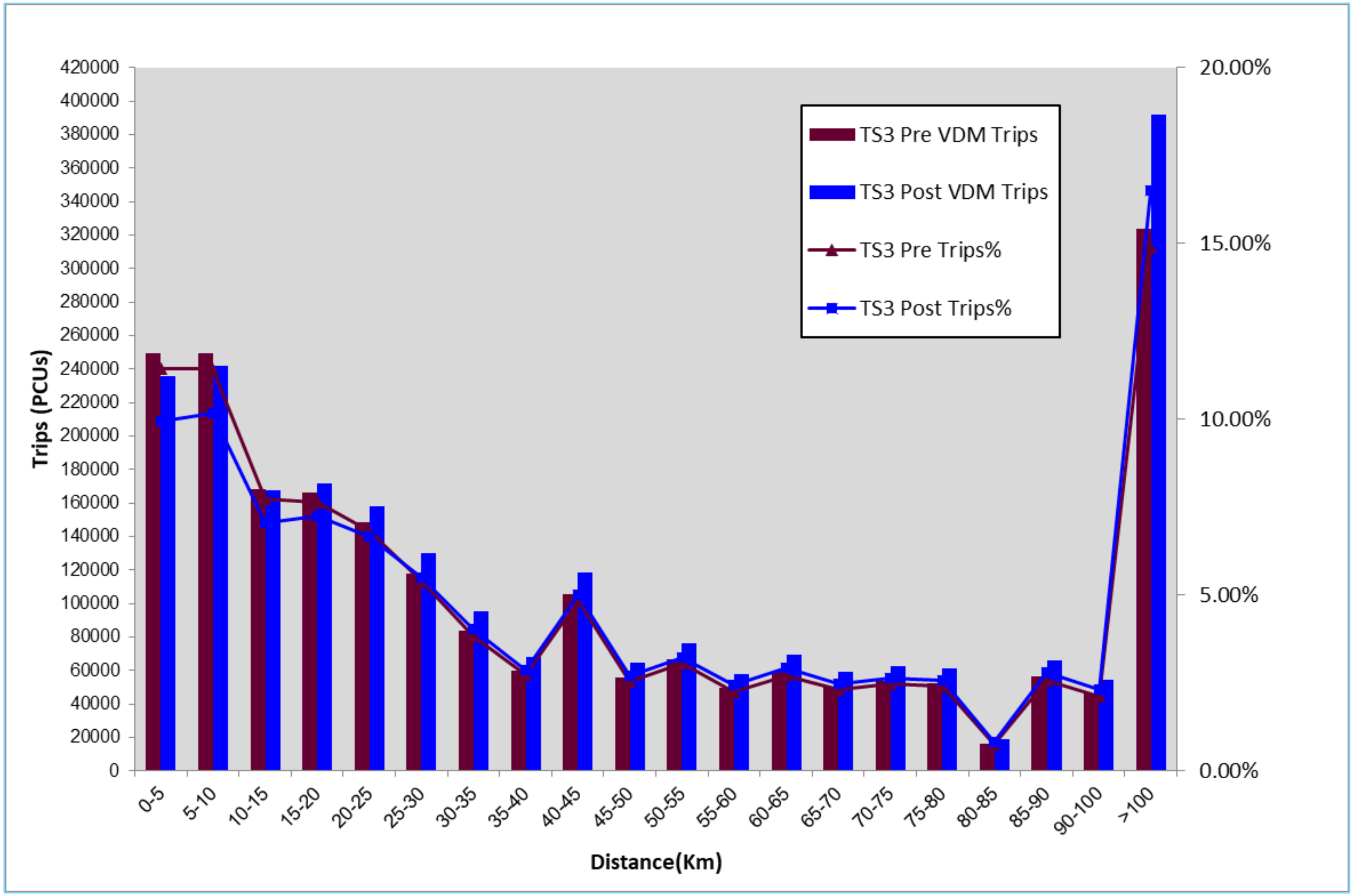


Figure 5-3 – Trip length distribution for 2042 PM Scenario Q pre vs. post VDM

6. Core Scenario Forecast Results

6.1. Overview

6.1.1. This chapter presents the results of the all the scenarios developed using forecasts based on the variable demand assignments for scenario Q. Analysis of the traffic impacts focuses on the following comparisons between the scenarios:

- Overall assignment statistics across the model forecast years;
- Analysis of the change in traffic flows compared against the scenario P to scenario R;
- Analysis of the change in Volume over Capacity (V/C) ratio across the study area to provide a further understanding of the changes in congestion resulting from the scheme;

6.2. Overall Assignment Statistics

6.2.1. Global summary statistics for each of the model scenarios have been analysed to understand the overall differences between different scenario and as a general check in terms of the consistency between the different assignments. Summary statistics, focusing on the overall area of the model (Simulation + Buffer) are presented for each modelled time period in Table 25, Table 26 and Table 27 for the AM, IP and PM peaks respectively.

6.2.2. Analysis of these statistics demonstrates that:

- All future year scenarios show incremental increases in both total travel time and distances from the 2015 base model year to the 2027, 2034 and 2042 forecasts during each time period. This is to be expected given the scale of the modelled area versus the scheme improvement and the increasing levels of traffic between forecast years;
- As shown in the Table 24 below, the total demand would remain same for the scenarios P & S and similarly between scenarios Q & R. VDM run was undertaken only for the scenario Q. The demand for all other scenarios i.e., P and S was derived from scenario Q post VDM demand matrices. For the forecast year 2027, there is some planned development for JCS, hence the demand for 2027 is calculated in the same way as of 2042 by applying reduction factor to the VDM matrices for P & S scenario
- the vehicle kilometres travelled are not too different from each scenario for a given forecast year;
- Average network speeds almost remain same across various scenario for respective forecast year and time period; and
- Assignment models have achieved convergence in line with TAG for all forecast years and scenarios.

Table 24 – Combinations of Scenarios with/without dependent development and the transport scheme

	Without Dependent Development	With Dependent Development
Without transport scheme	P	Q
With transport scheme	S	R

Table 25 – AM peak Period Assignment Summary Statistics

Statistic	Base	2027				2034				2042			
		P	S	Q	R	P	S	Q	R	P	S	Q	R
Total Assigned Trips (PCUs in 000's)	1,799	1,999	1,999	1,999	1,999	2,130	2,130	2,132	2,132	2,294	2,294	2,298	2,298
Total Travel Time (PCU-hrs in 000's)	1,361	1,554	1,554	1,554	1,554	1,697	1,697	1,698	1,698	1,889	1,888	1,891	1,890
Travel Distance (PCU-kms in 000's)	95,236	105,356	105,357	105,364	105,365	115,442	115,444	115,480	115,482	128,929	128,931	128,992	128,992
Average Journey Speed (kph)	70.0	67.8	67.8	67.8	67.8	68.0	68.0	68.0	68.0	68.3	68.3	68.2	68.2
Loops (N)	29	32	32	35	34	33	34	43	32	35	42	52	41
%Flows	99.5	99.6	99.6	99.8	99.8	99.6	99.8	99.9	99.8	99.7	99.7	99.7	99.7
%Delays	99.8	99.5	99.8	99.6	99.6	99.5	99.8	99.6	99.5	99.5	99.7	99.6	99.6

Table 26 – Inter-Peak Period Assignment Summary Statistics

Statistic	Base	2027				2034				2042			
		P	S	Q	R	P	S	Q	R	P	S	Q	R
Total Assigned Trips (PCUs in 000's)	1,385	1,549	1,549	1,549	1,549	1,665	1,665	1,667	1,667	1,813	1,813	1,816	1,816
Total Travel Time (PCU-hrs in 000's)	971	1,122	1,122	1,122	1,122	1,240	1,240	1,241	1,241	1,404	1,404	1,406	1,406
Travel Distance (PCU-kms in 000's)	73,093	81,283	81,286	81,286	81,290	90,188	90,191	90,213	90,217	102,476	102,478	102,521	102,524
Average Journey Speed (kph)	75.3	72.4	72.4	72.4	72.4	72.7	72.7	72.7	72.7	73.0	73.0	72.9	72.9
Loops (N)	15.0	24	24	21	21	19	17	31	16	19	16	21	18
%Flows	99.9	99.9	99.6	99.7	99.9	100.0	99.8	99.8	99.9	99.8	99.8	99.8	99.8
%Delays	99.9	99.9	99.9	99.8	99.9	100.0	99.9	99.9	99.9	99.8	99.9	99.8	99.8

Table 27 – PM Peak Period Assignment Summary Statistics

Statistic	Base	2027				2034				2042			
		P	S	Q	R	P	S	Q	R	P	S	Q	R
Total Assigned Trips (PCUs in 000's)	1,833	2,035	2,035	2,035	2,035	2,183	2,183	2,185	2,185	2,368	2,368	2,372	2,372
Total Travel Time (PCU-hrs in 000's)	1,306	1,495	1,495	1,495	1,495	1,649	1,649	1,650	1,650	1,858	1,858	1,860	1,860
Travel Distance (PCU-kms in 000's)	92,231	101,987	101,989	101,992	101,995	112,949	112,950	112,984	112,986	127,757	127,758	127,819	127,820
Average Journey Speed (kph)	70.6	68.2	68.2	68.2	68.2	68.5	68.5	68.5	68.5	68.8	68.8	68.7	68.7
Loops (N)	26.0	39	33	36	40	40	38	38	34	33	32	34	32
%Flows	99.7	99.7	99.8	99.8	99.6	99.7	99.9	99.7	99.6	99.6	99.7	99.8	99.6
%Delays	99.6	99.5	99.6	99.7	99.5	99.7	99.6	99.4	99.2	99.3	99.4	99.3	99.3

6.3. Traffic Analysis in Core Study Area

6.3.1. Having considered how traffic is using the M5 J10 and A4019 link for each of the scenarios, it is important to analyse how this affects the use of the surrounding local and strategic road network in terms of changing traffic volumes. In addition, given the local nature of the scheme there is also a requirement to consider how the dependent and dead weight developments are using the scheme.

6.3.2. There are four modelling scenarios developed as part of this study in accordance with TAG Unit A2.2 which is aimed for the schemes that are primarily implemented to unlock developments. These scenarios have been outlined earlier in section 2.4 of the report and are referenced to as P, Q, R and S.

6.3.3. There are two demand types present in these four modelling scenarios. Scenarios Q and R have the same demand which includes both the deadweight development (not dependent on implementation of the proposed transport scheme) as well as developments which are dependent on the proposed transport scheme. The difference between these two scenarios is the exclusion from the proposed transport scheme in Scenario Q and its inclusion in Scenario R.

6.3.4. Scenarios P and S have the same demand which consist of deadweight developments but exclude the dependent developments. The difference between these two scenarios is again the exclusion of the proposed transport scheme from Scenario P and its inclusion in Scenario S.

6.3.5. Depending upon the purpose of the analysis there can be a myriad of comparisons between the four modelling scenarios developed for this commission. In the context of this study, the implementation of the proposed transport scheme and constructing the dependent developments are interdependent. In another word, the proposed transport scheme would not be implemented without construction of the dependent developments and vice-versa.

6.3.6. For the reporting purposes of this study, outputs from scenarios P and R have been deemed most appropriate as they represent both the demand and supply (transport scheme provision) in the two scenarios under consideration. Hence, they are presented in the main section of the report. Scenario P represents the situation where both demand from the dependent developments and the transport scheme needed to unlock them are excluded from the modelling whereas Scenario R includes both the demand from the dependent developments and the proposed transport scheme.

6.3.7. The outputs from Scenario Q in comparisons with Scenario P and Scenario R are presented in Appendix E. The comparison of Scenario Q against Scenarios P and R show the impact of the dependent development trips on the highway network without and with the proposed scheme respectively.

6.3.8. Scenarios P and R in the case of the M5 J10 scheme which is a scheme proposed to unlock certain new developments can be considered to represent the so called Do-Minimum and Do-Something scenarios in the traditional highway schemes which aim to address a specific traffic related issue.

6.3.9. Analysis undertaken to understand these changes in traffic volume includes:

- Flow difference analysis across simulation links in the core study area;
- Focussed analysis of delay difference for simulation links in the core study area; and
- Focussed analysis of Volume over Capacity (V/C) ratio for simulation links in the core study area.

Flow difference analysis

6.3.10. To provide an idea of the overall changes in traffic levels, the modelled actual flow difference for all links in the core study area are shown in Figure 6-1 to Figure 6-6 for scenario R minus P (*scenario R includes both demand for all developments and also M5 J10 proposed scheme whilst scenario P excludes both demand from dependent developments and proposed M5 J10 scheme*).

6.3.11. Analysing figures 6-1 to 6-6 show that:

- As expected, Scenario R demonstrates increase in flow along the motorway between M5 J11 and M5 J10, some traffic diverts to use the new motorway roundabout which offers a faster more direct route for strategic movements between motorway and Cheltenham town centre. An increase of between 400 veh/hr and 1000 veh/hr are seen on this section in 2027 and 2042 respectively.
- North of the M5 J11 roundabout, there are increases in traffic along the local route around A40 corridor, this shows that adding the all movement junction 10 along the M5 motorway would attract trips from local routes and some trips are shifting to motorway corridor between M5 J10 and J11.
- M5 motorway: In 2042 there is modest drop in in traffic north of J10 (around 2%). Between M5 J10 and J11, and south of J11 the peak hour traffic volumes increase by about 9% to 23% in both directions.
- A4019 between M5 J10 and Elms Park Development: 2042 PM peak hour traffic volumes increase around 102%. Traffic volumes reaches up to 1600 vehicles in the hour, which exceed the capacity for a single carriageway.
- A4019 between J10 and Stoke Road: peak hour traffic volumes increase by 63% to 100% in both directions (up to 670 vehicles in the hour).
- A4019 between Stoke Road and Coombe Hill: peak hour traffic volumes increase by 12% to 16% in both directions (up to 150 vehicles).
- Stoke Road: An increase of peak traffic volumes (by up to 450 vehicles) is observed in 2042 AM peak.
- B4634 Old Gloucester Road (east and west of link road junction): In 2042 there is increase in traffic by about 9% (upto 100 vehicles) to 27% (upto 200 vehicles) in both directions.

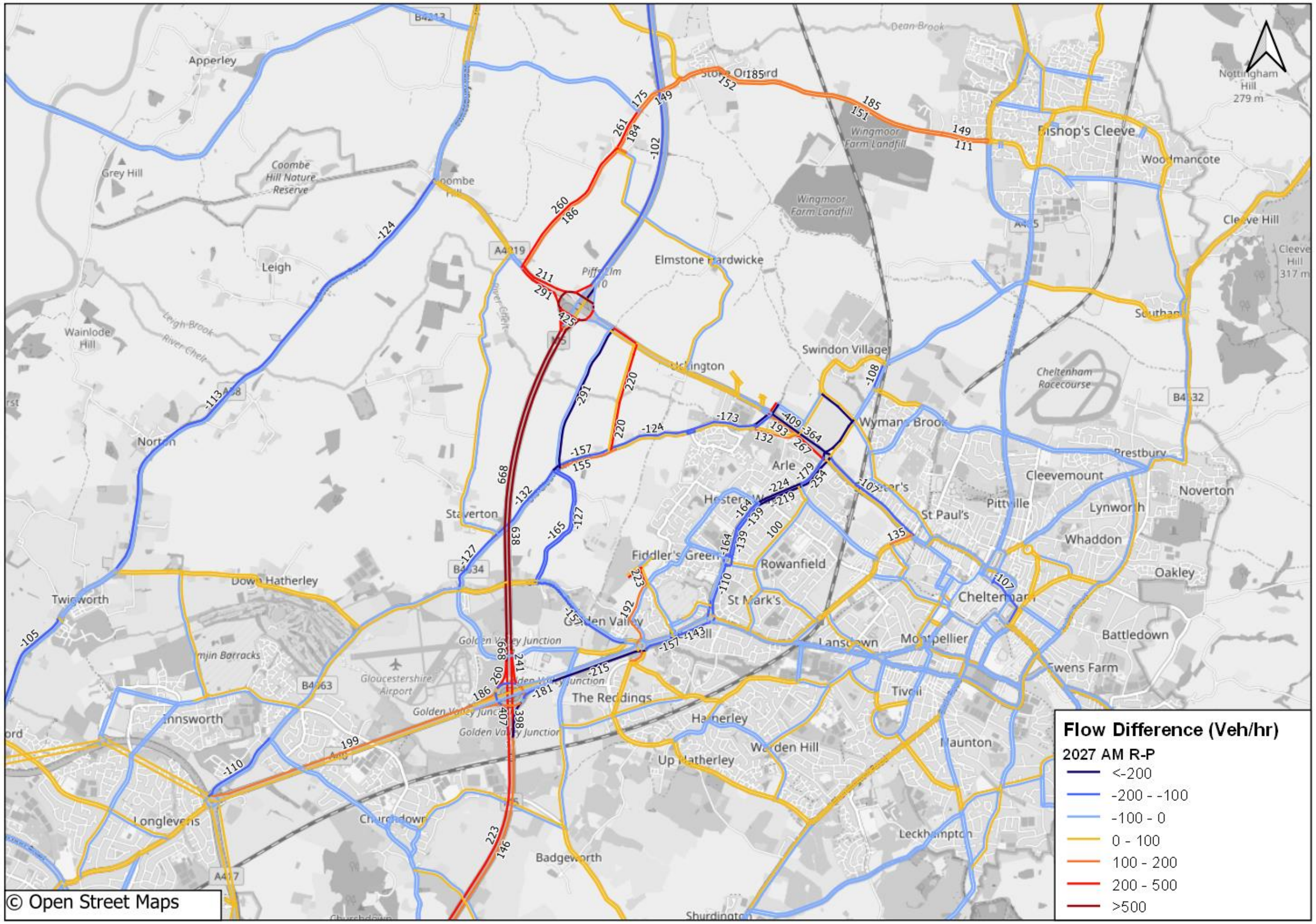


Figure 6-1 – Scenario R minus Scenario P – 2027 AM peak flow difference in scheme area (In Vehicles)

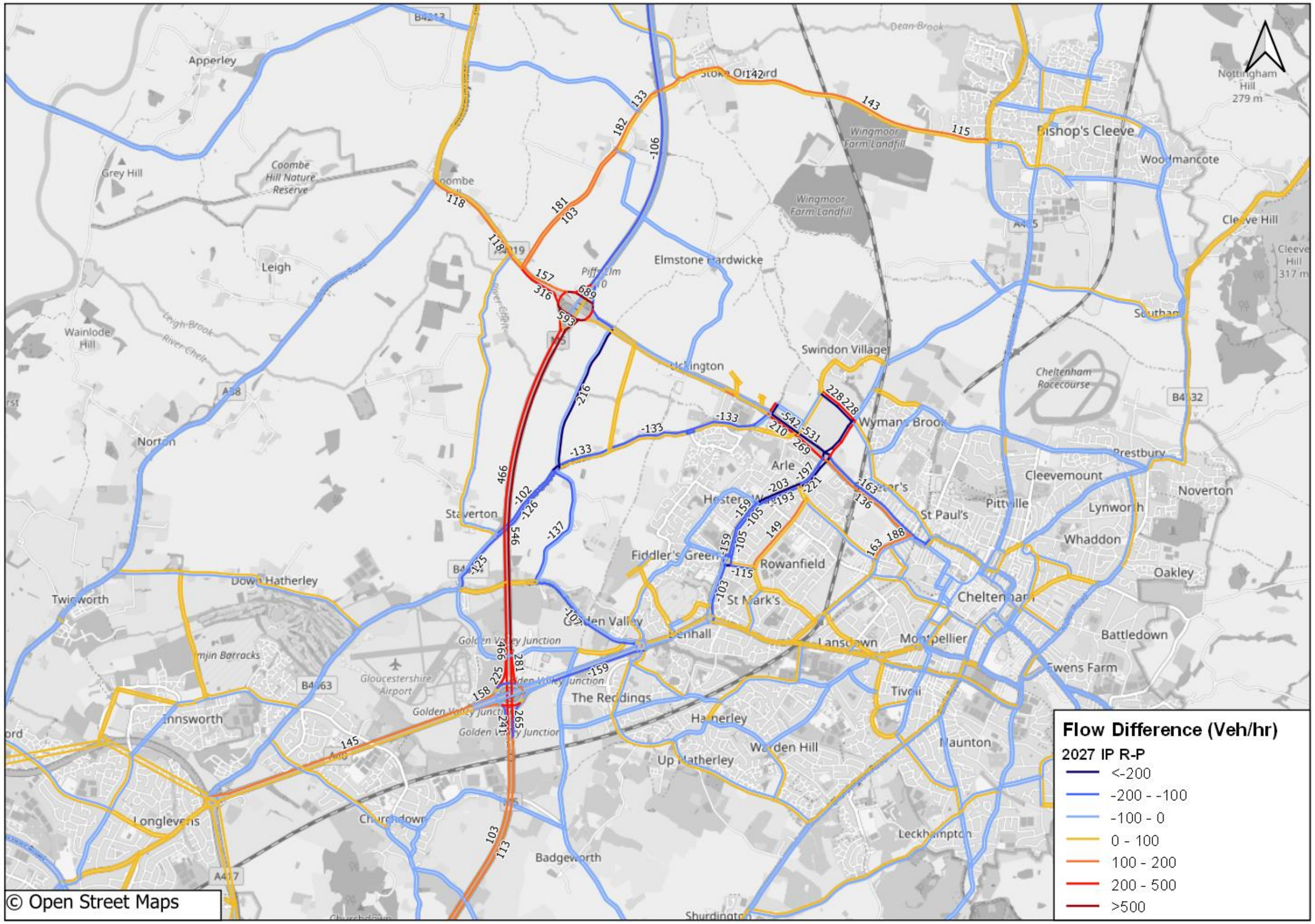


Figure 6-2 – Scenario R minus Scenario P – 2027 IP peak flow difference in scheme area (In Vehicles)

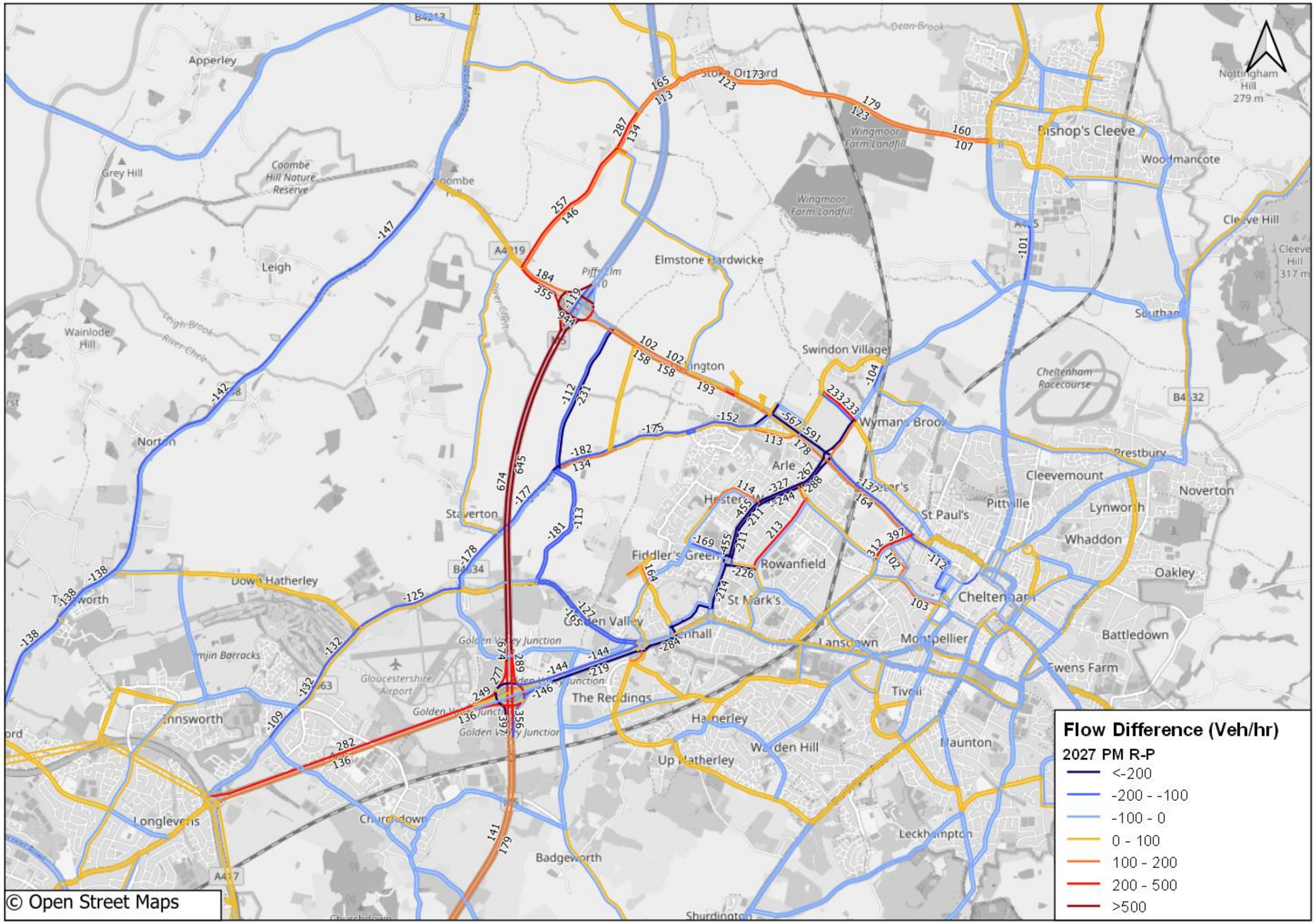


Figure 6-3 – Scenario R minus Scenario P – 2027 PM peak flow difference in scheme area (In Vehicles)

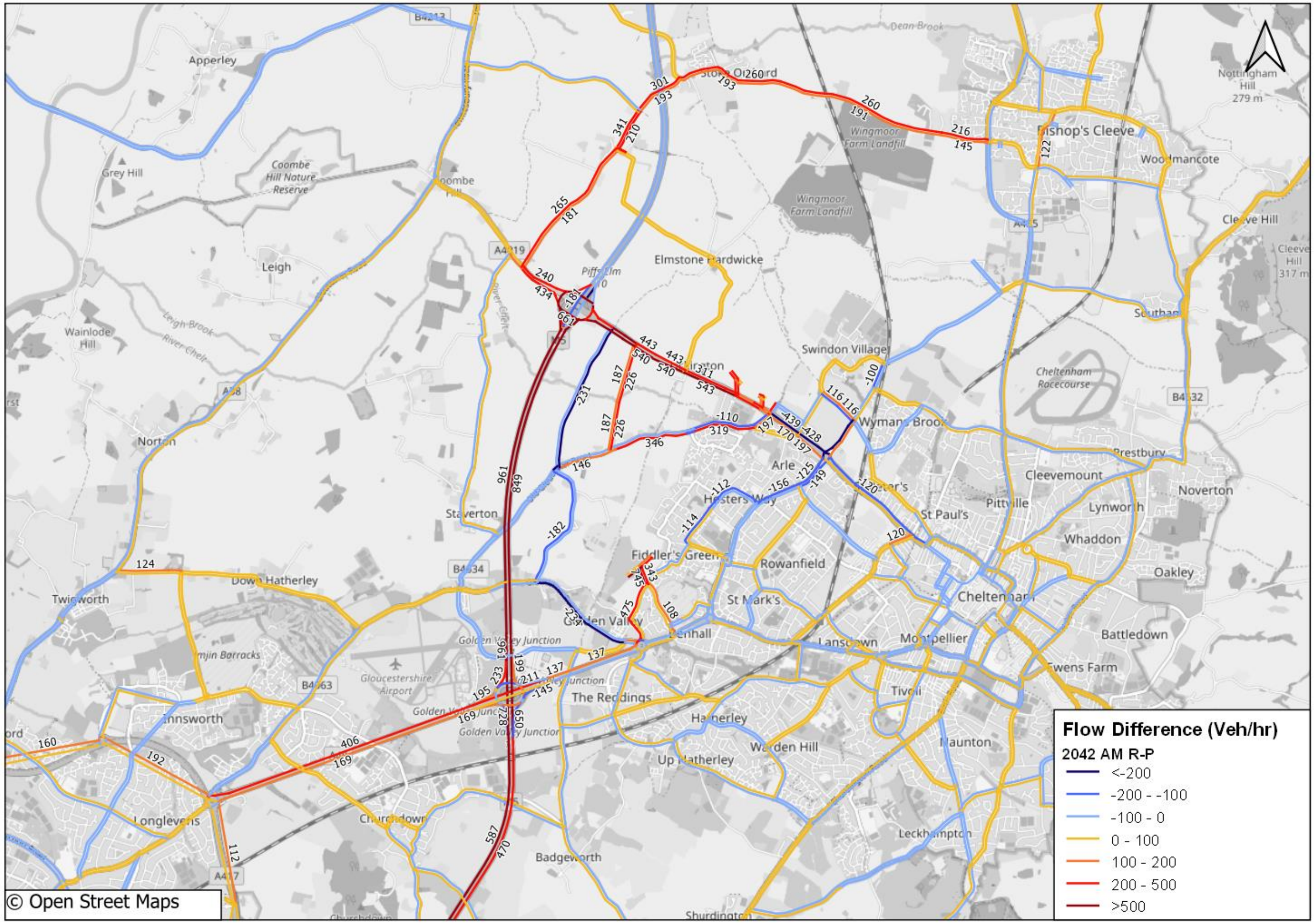


Figure 6-4 – Scenario R minus Scenario P – 2042 AM peak flow difference in scheme area (In Vehicles)

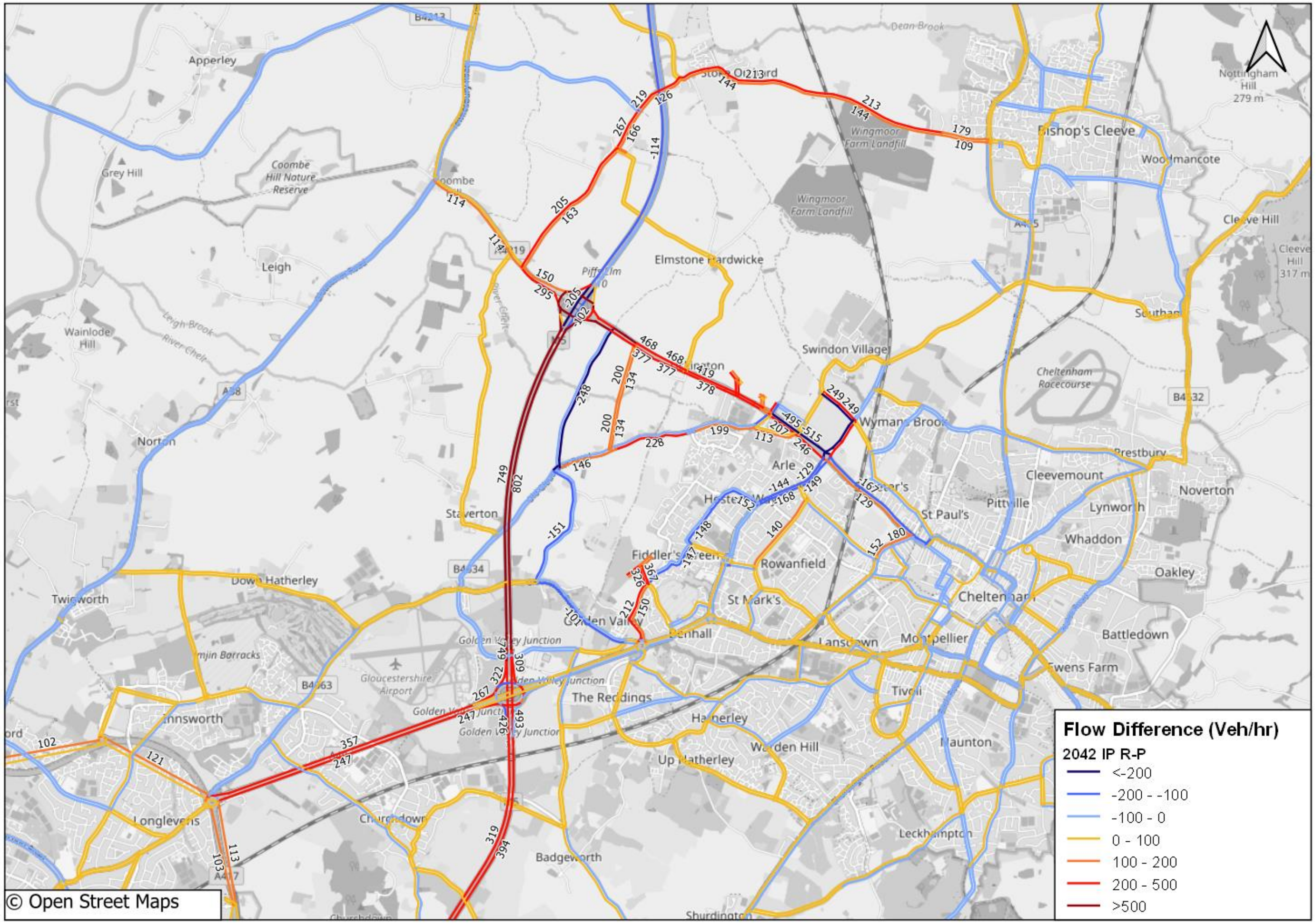


Figure 6-5 – Scenario R minus Scenario P – 2042 IP peak flow difference in scheme area (In Vehicles)

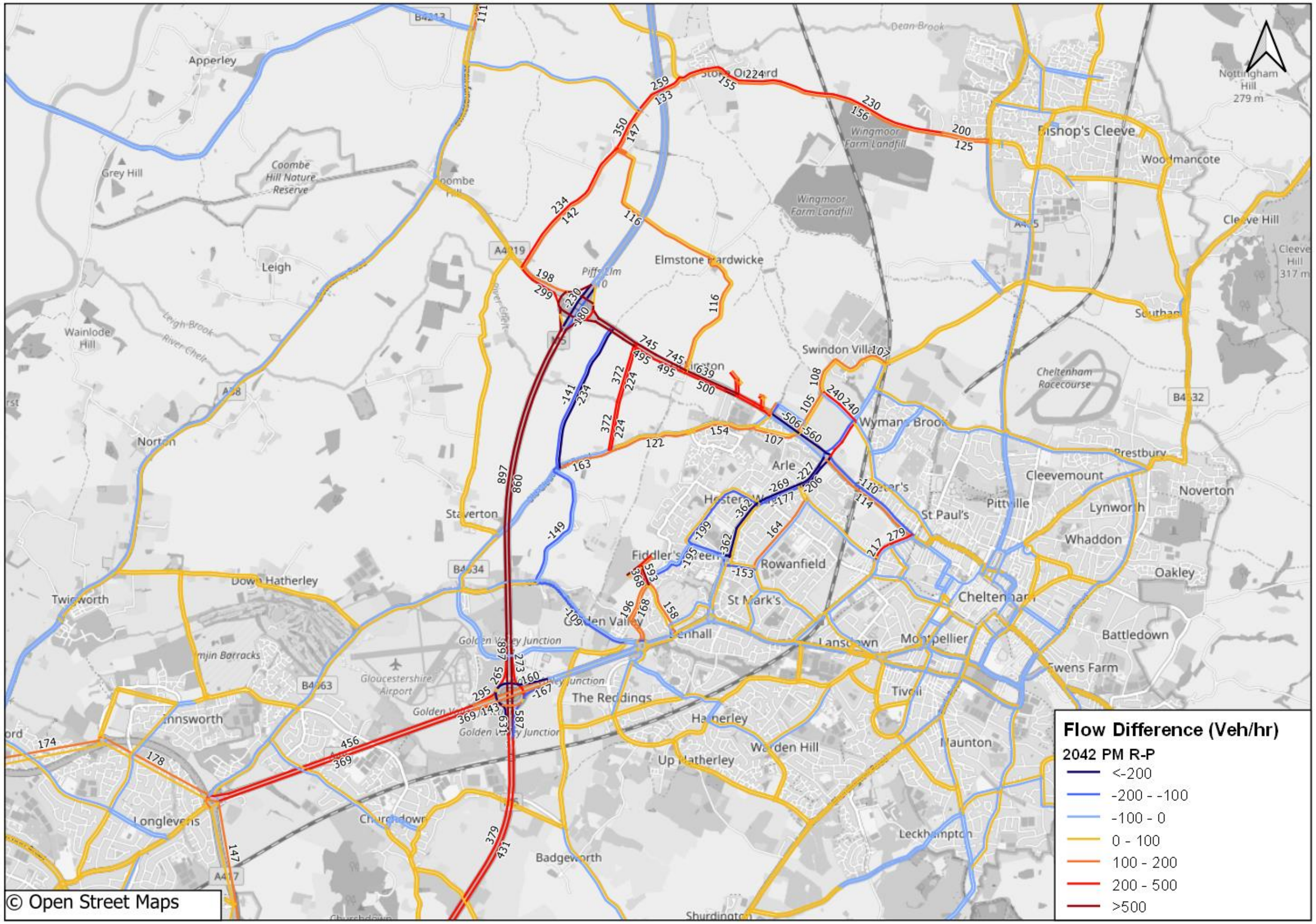


Figure 6-6 – Scenario R minus Scenario P – 2042 PM peak flow difference in scheme area (In Vehicles)

Journey time analysis

6.3.12. Analysis of the changes in journey times have been considered for three routes 1, 2 and 3 covering A4019, M5 between Junctions 9 and 11 and A38 as shown in the Figure 6-7 below.

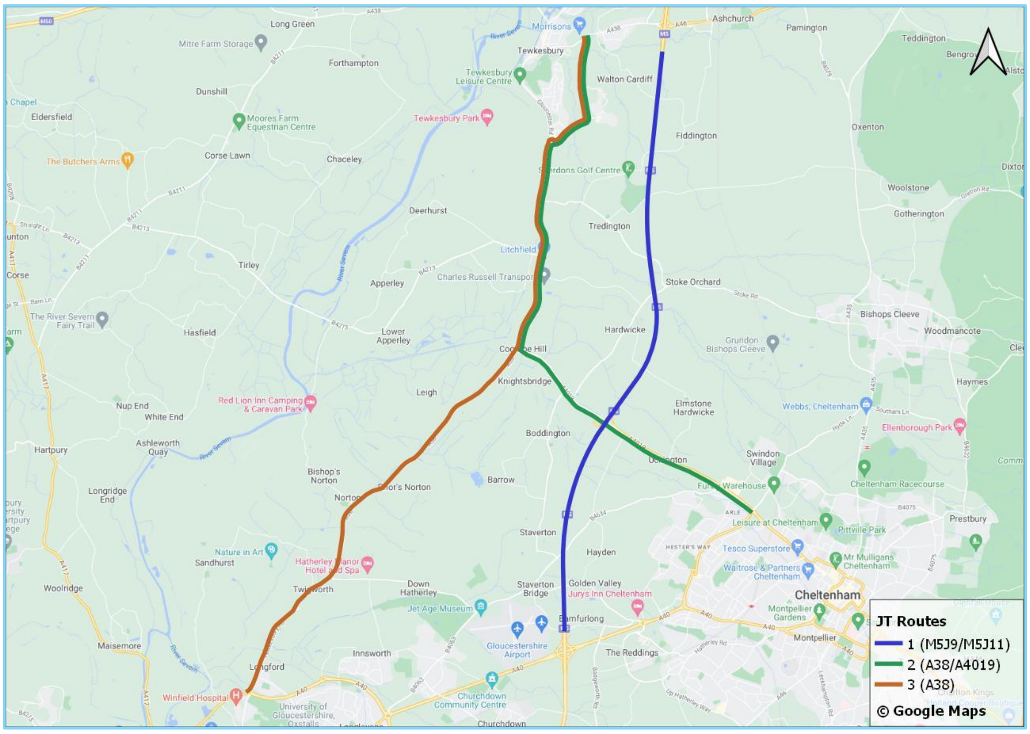


Figure 6-7 – Journey Time Routes

6.3.13. The results of the analysis are presented in Table 28 and Table 29 for each of the model forecast years during the AM and PM peak periods

Table 28 – 2027 Journey Time Changes (minutes : seconds)

Route Number	Distance (km)	Scenario P AM Peak	Scenario R AM Peak	Difference R-P AM Peak	Scenario P PM Peak	Scenario R PM Peak	Difference R-P PM Peak
1NB	11.55	07:17	07:30	00:13	08:20	08:36	00:16
1SB	11.49	07:37	08:01	00:24	07:27	07:59	00:32
2NB	13.33	20:14	19:58	-00:16	21:00	20:48	-00:12
2SB	13.34	19:03	20:46	01:43	16:17	18:44	02:27
3NB	15.17	17:09	16:36	-00:33	16:59	16:23	-00:36
3SB	15.15	17:22	16:56	-00:26	16:33	16:29	-00:04

6.3.14. In 2027, except for Route 2 Southbound, for other routes, there are modest change in journey times in AM peak and PM peak in the R scenario when compared to that of P.

6.3.15. The highest changes in journey times are reported as about 2 minutes increase in the Route 2 Southbound and saving of 36 seconds along Route 3 Northbound.

Table 29 – 2042 Journey Time Changes (minutes : seconds)

Route Number	Distance (km)	Scenario P AM Peak	Scenario R AM Peak	Difference R-P AM Peak	Scenario P PM Peak	Scenario R PM Peak	Difference R-P PM Peak
1NB	11.55	08:08	08:39	00:31	09:34	10:11	00:37
1SB	11.49	08:23	09:20	00:57	08:21	09:41	01:20
2NB	13.33	19:53	21:27	01:34	21:27	22:21	00:54
2SB	13.34	19:48	23:55	04:07	16:23	20:11	03:48
3NB	15.17	17:09	17:41	00:32	17:45	17:12	-00:33
3SB	15.15	17:41	17:47	00:06	17:04	17:37	00:33

6.3.16. In 2042, with higher demand an increase of journey times is observed for most of the routes in scenario R compared to scenario P in both AM and PM peaks.

6.3.17. The highest changes in journey times are reported as about 4 minutes increase in the Route 2 Southbound and saving of 30 seconds along Route 3 Northbound.

Delay difference analysis

6.3.18. In addition to analysing the flow differences, changes in network delay for links across the model study area have also been considered to better understand the impact of the proposed scheme on congestion.

6.3.19. Figure 6-8 to Figure 6-13 show the changes in delay for scenario R compared against scenario P for the 2027 and 2042 AM peak, IP and PM peak.

6.3.20. The comparisons demonstrate the following key points:

- Consistent with the analysis of the changes in flow difference plots, scenario R demonstrate the clear reductions in delay on local routes and increase in delay on the motorway between M5 J10 and J11 in both 2027 and 2042 during AM and PM time periods, owing to the large increase in traffic using the proposed Junction 10 all movement roundabout.
- Conversely, all time periods for scenario R also demonstrate the increasing levels of delay on Stoke Road to the east of the scheme. Investigation of these changes in the model highlights this is primarily related to rerouting of trips as junctions on A4019 reach their capacity, with traffic levels exceeding the link capacity.
- There are some notable decreases in delay in areas of Cheltenham and Bishops Cleeve, particularly at the A4019/Princess Elizabeth Way junction. This is a result of less traffic using the local road network.

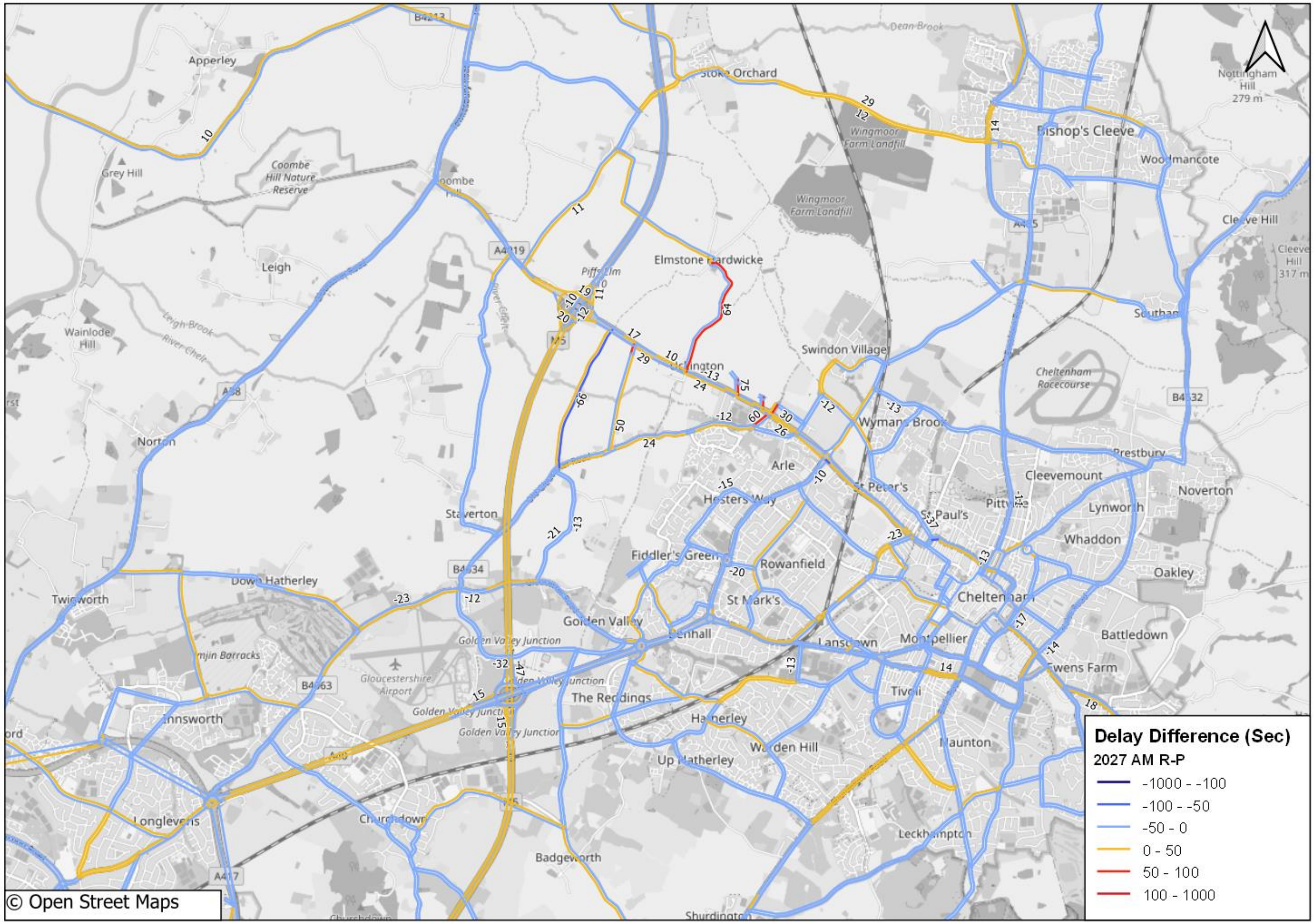


Figure 6-8 – Scenario R minus Scenario P – 2027 AM peak delay difference in scheme area (In Seconds)

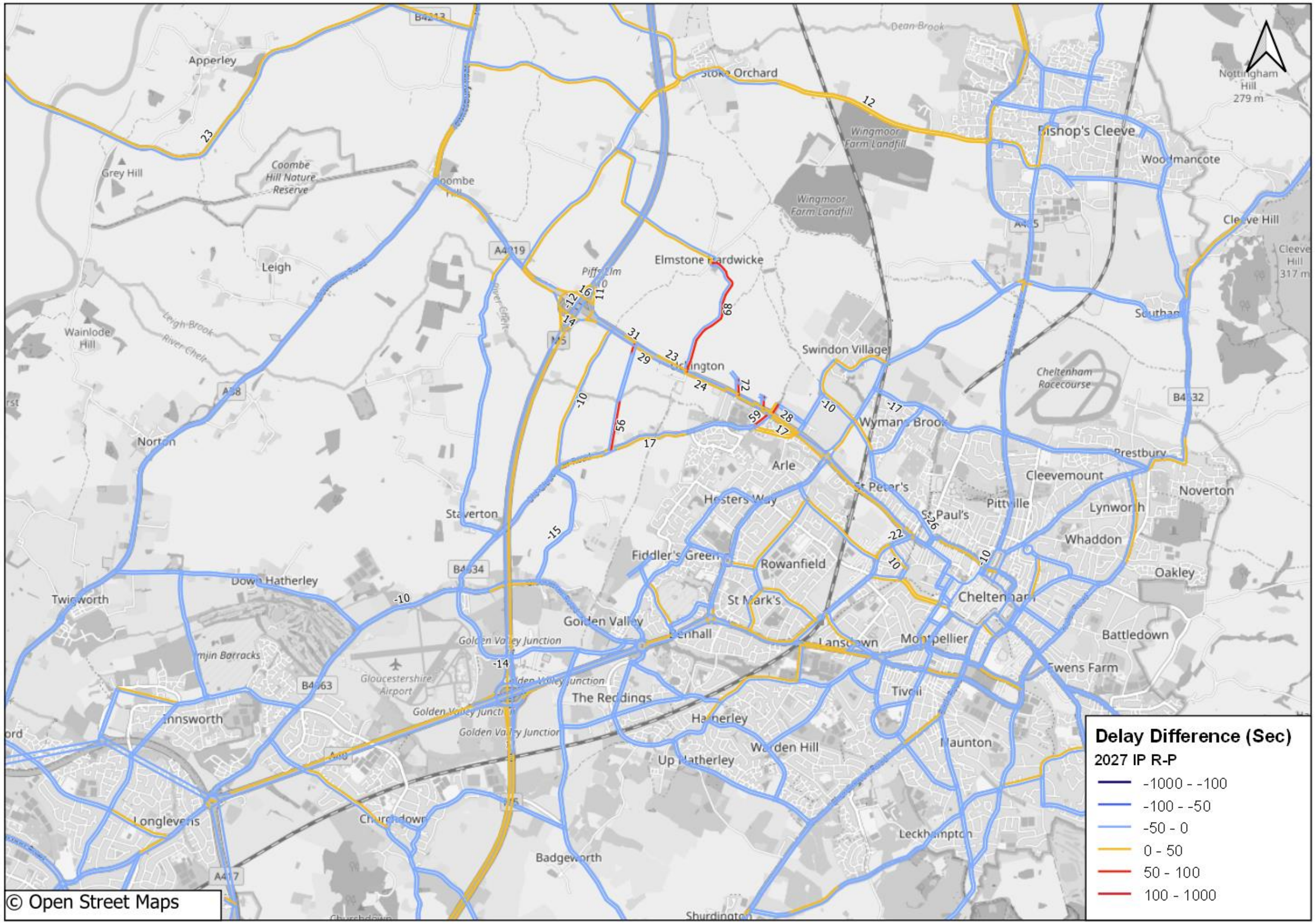


Figure 6-9 – Scenario R minus Scenario P – 2027 IP peak delay difference in scheme area (In Seconds)

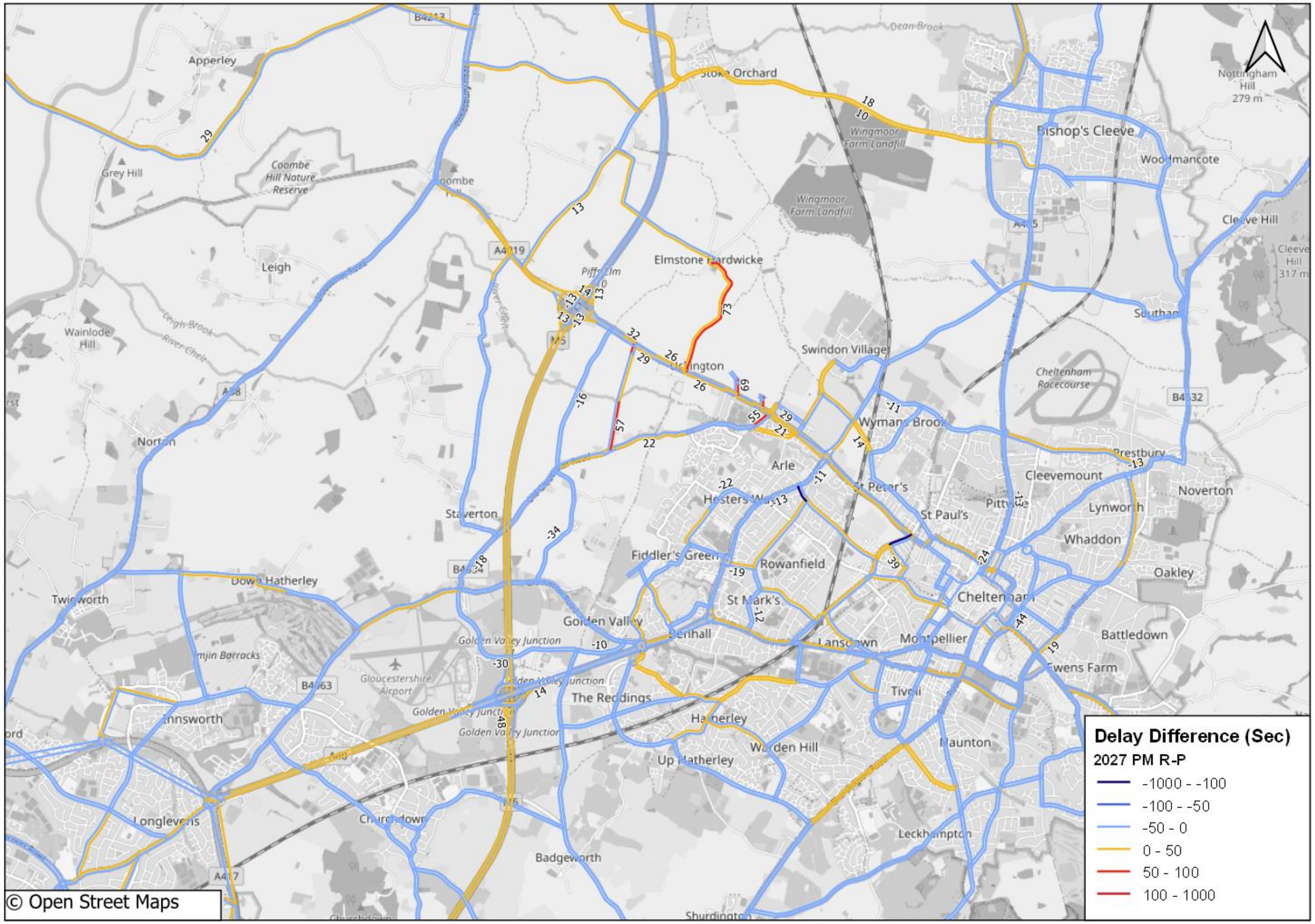


Figure 6-10 – Scenario R minus Scenario P – 2027 PM peak delay difference in scheme area (In Seconds)

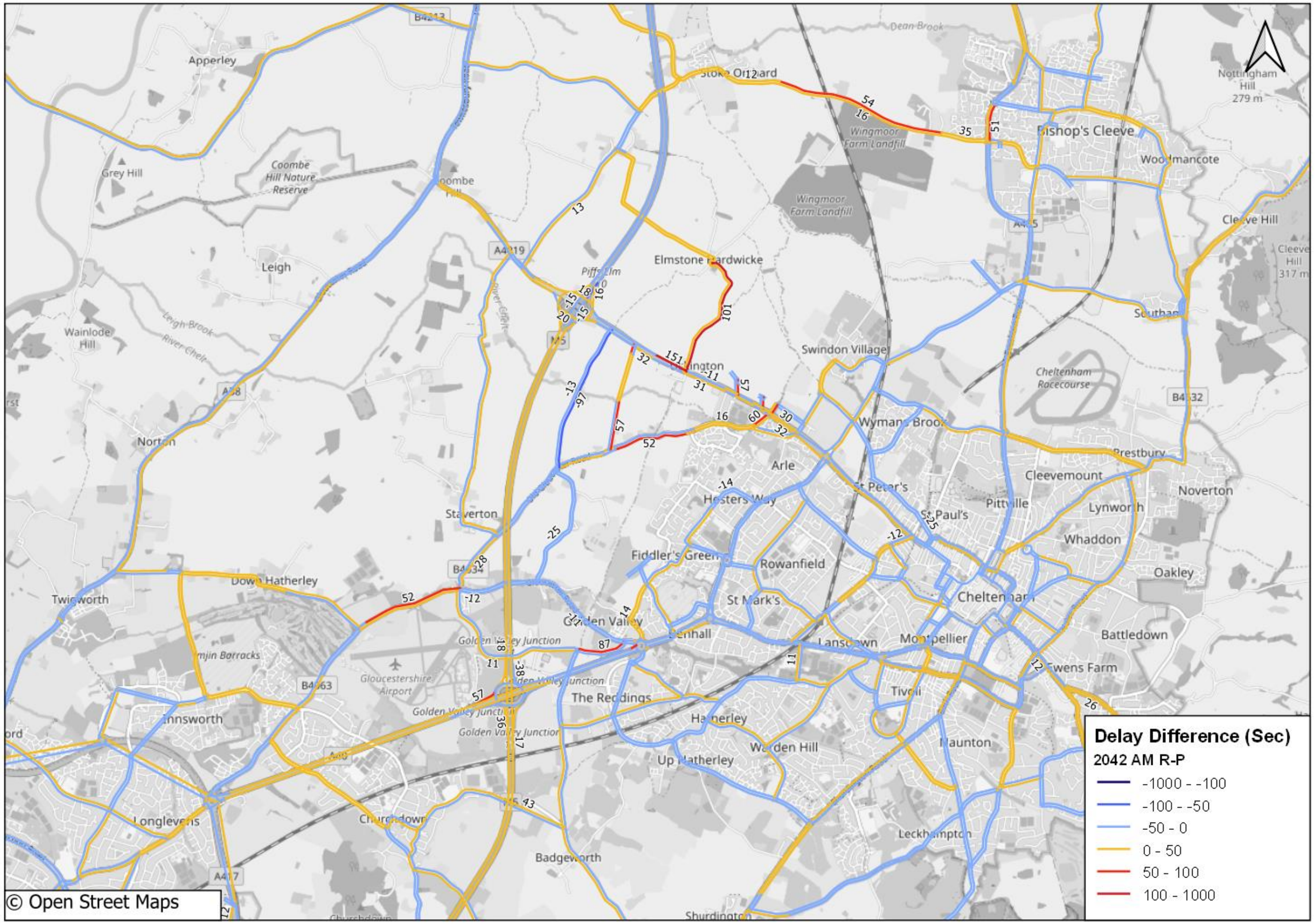


Figure 6-11 – Scenario R minus Scenario P – 2042 AM peak delay difference in scheme area (In Seconds)

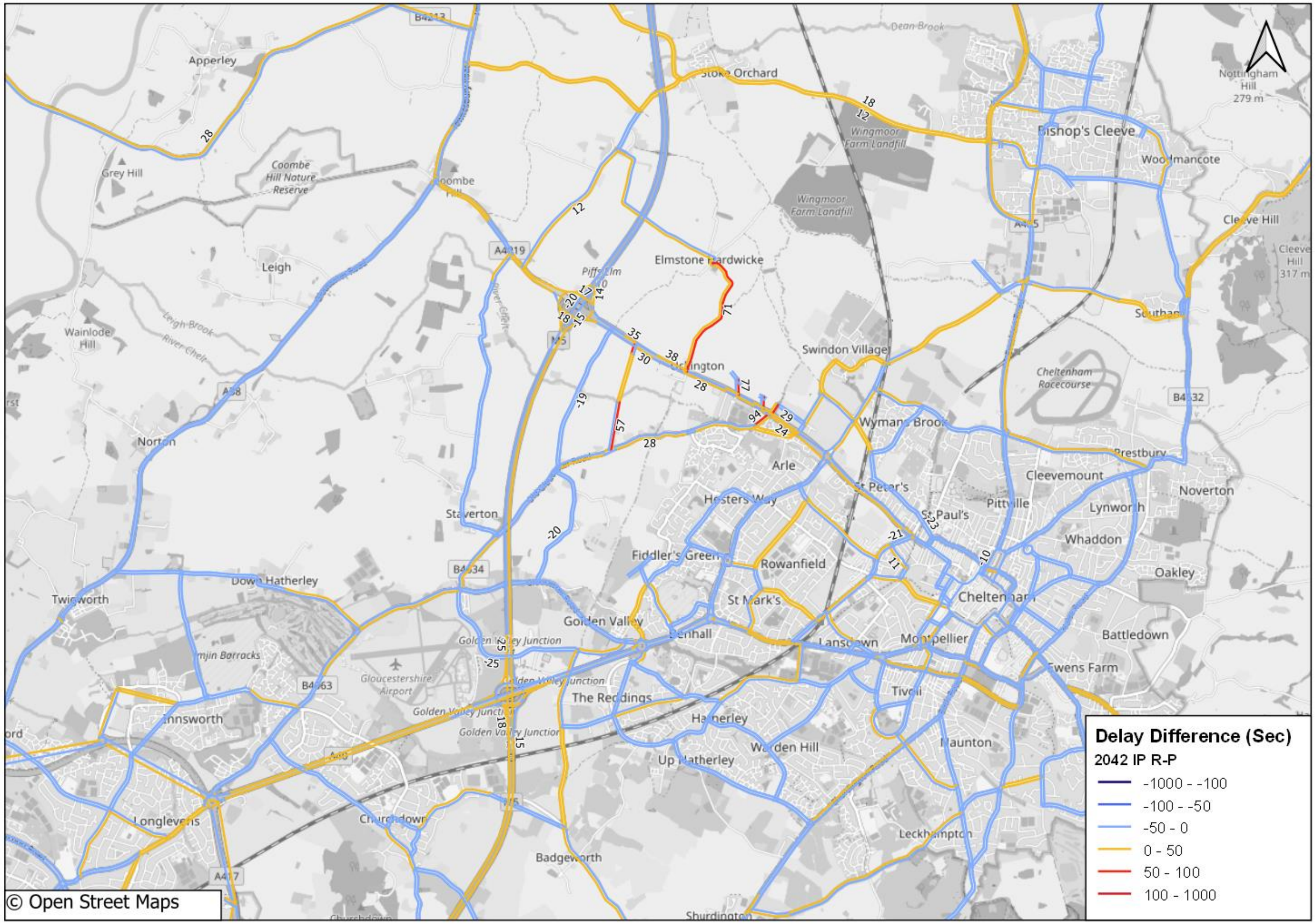


Figure 6-12 – Scenario R minus Scenario P – 2042 IP peak delay difference in scheme area (In Seconds)

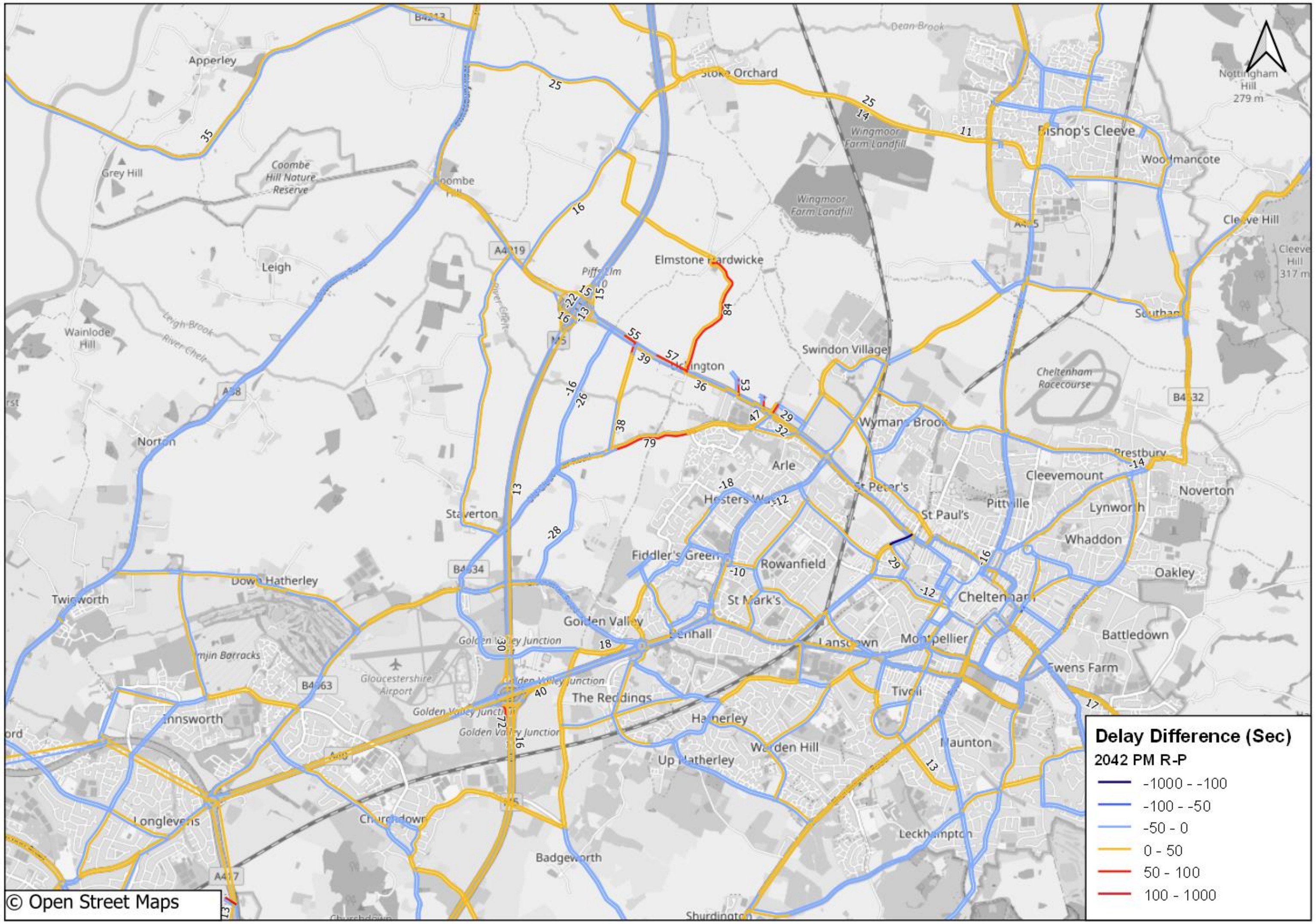


Figure 6-13 – Scenario R minus Scenario P – 2042 PM peak delay difference in scheme area (In Seconds)

Volume over capacity analysis

6.3.21. In addition to analysing flow difference and changes in the network delay, changes in V/C ratio for scenarios R and P links across the model study area have also been considered to better understand the proposed scheme on performance of the network.

6.3.22. Figure 6-14 to Figure 6-19 show the V/C ratio plot for scenarios R and P for 2042 AM peak, IP and PM peak.

6.3.23. The comparisons demonstrate the following key points:

- Scenario R shows the slight reductions in V/C on local routes and increase in V/C on Motorway between M5 J10 and M5 J11 during both AM and PM time periods, owing to the large increase in traffic using the J10 all movement junction.
- No significant changes in V/Cs were observed in Inter peak between scenarios P and R.
- These results are from SATURN strategic model which has limitations in modelling merge, diverge, and weaving impacts in detail. Operational modelling is recommended to assess and identify any operational issues at junctions.

6.3.24. The quantum of the deadweight (the JCS developments which are not dependent on implementation of the proposed scheme) was established in 2019 as part of the original HIF submission based on a dependency test using the then traffic model. As mentioned in Section 2.3 the same assumptions with regard to the quantum of deadweight have been maintained in the current submission. A sensitivity test has been undertaken with the current traffic model to establish the impact of varying the deadweight on the overall performance of the proposed scheme. A summary of the original dependency test and results of the sensitivity test are included in Appendix E.

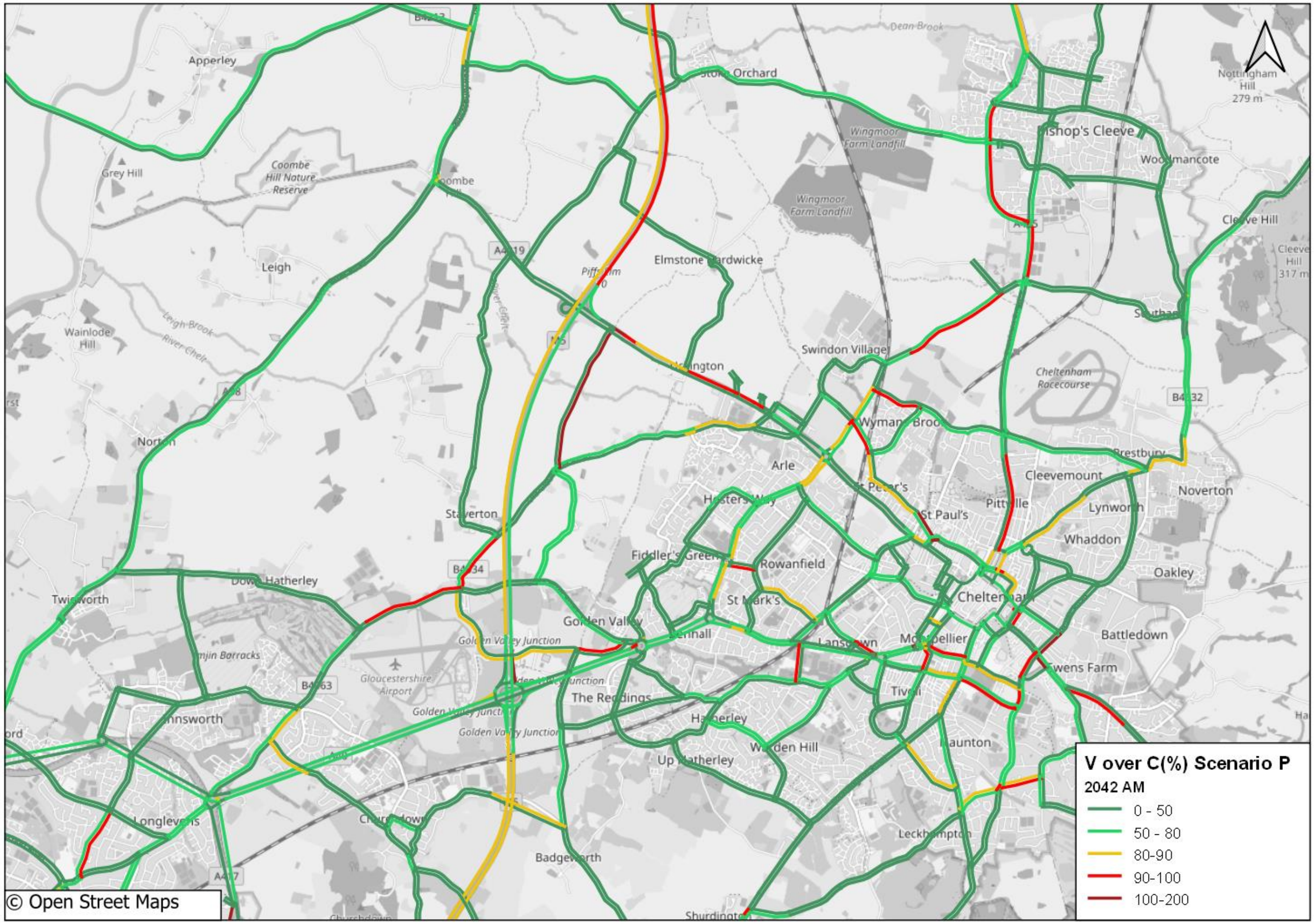


Figure 6-14 – Scenario P 2042 AM peak V/C in scheme area

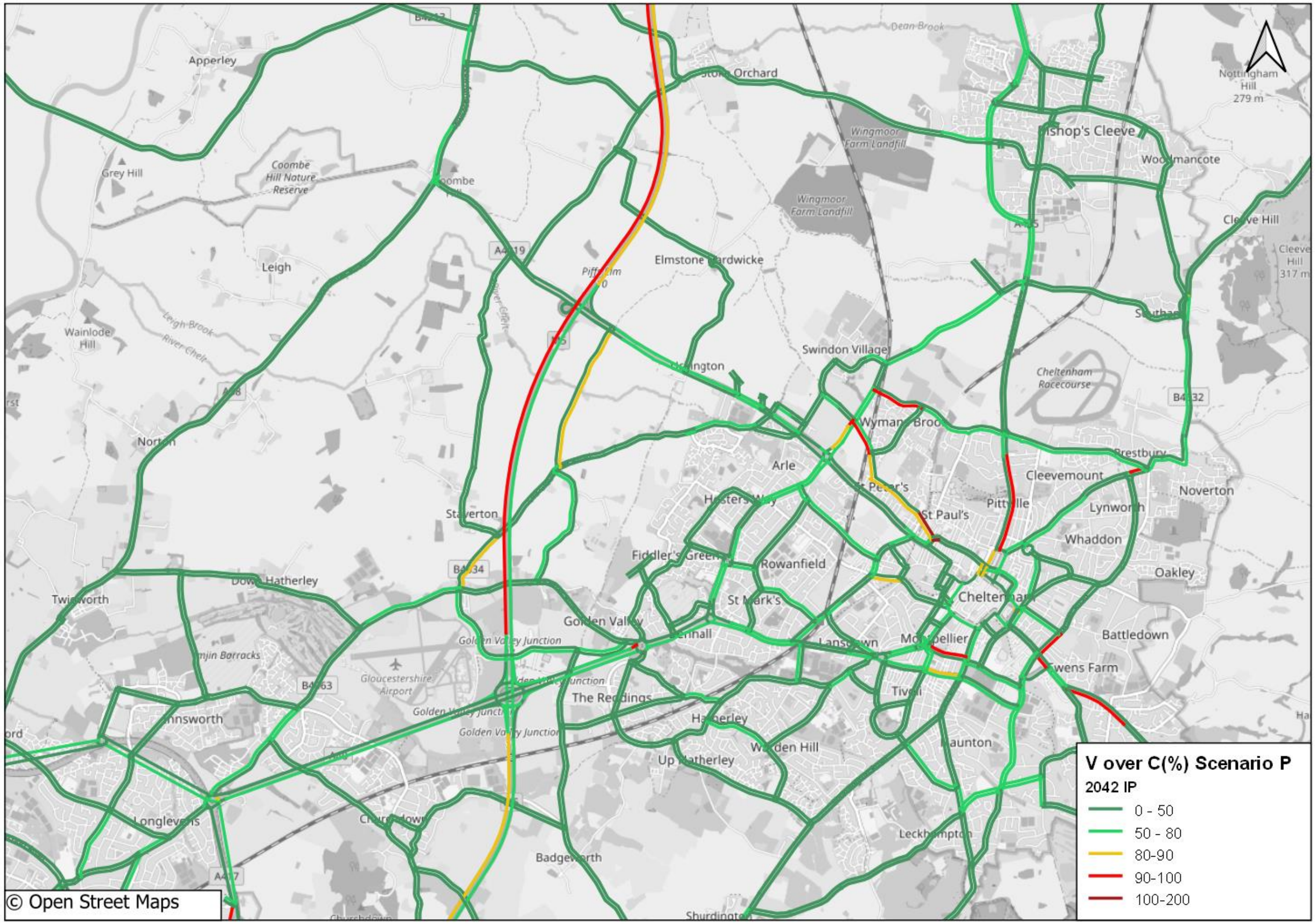


Figure 6-15 – Scenario P 2042 IP peak V/C in scheme area

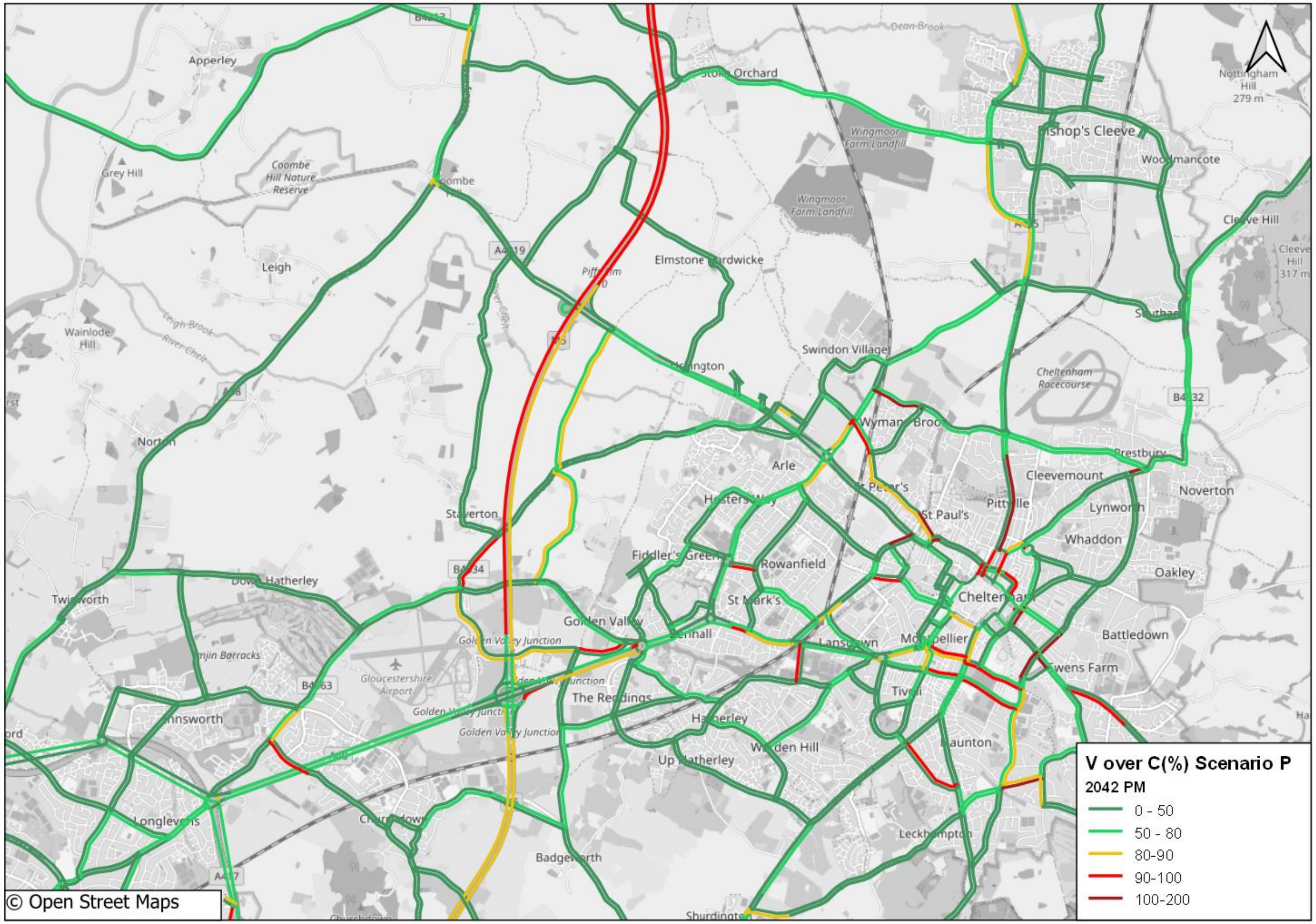


Figure 6-16 – Scenario P 2042 PM peak V/C in scheme area

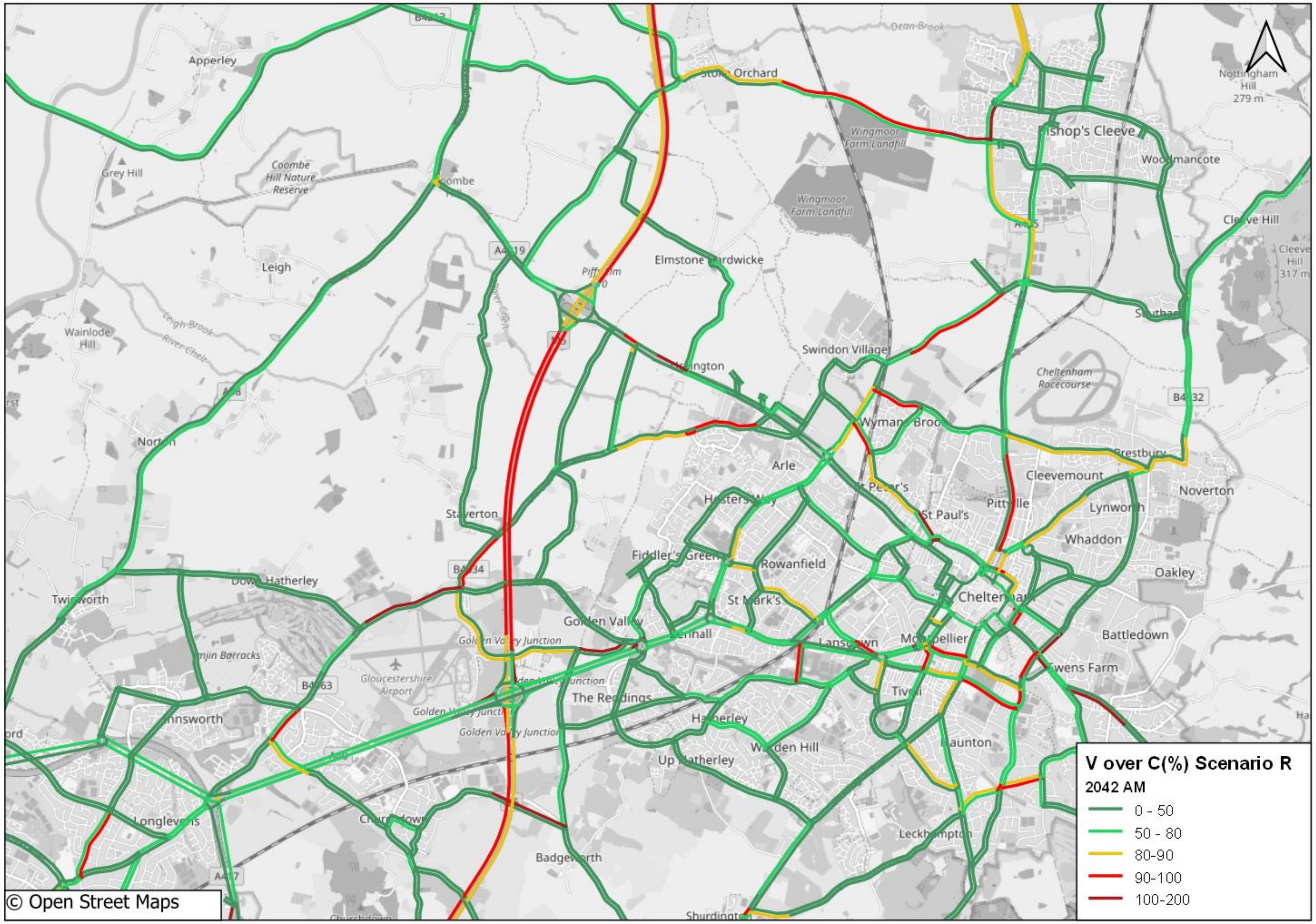


Figure 6-17 – Scenario R 2042 AM peak V/C in scheme area

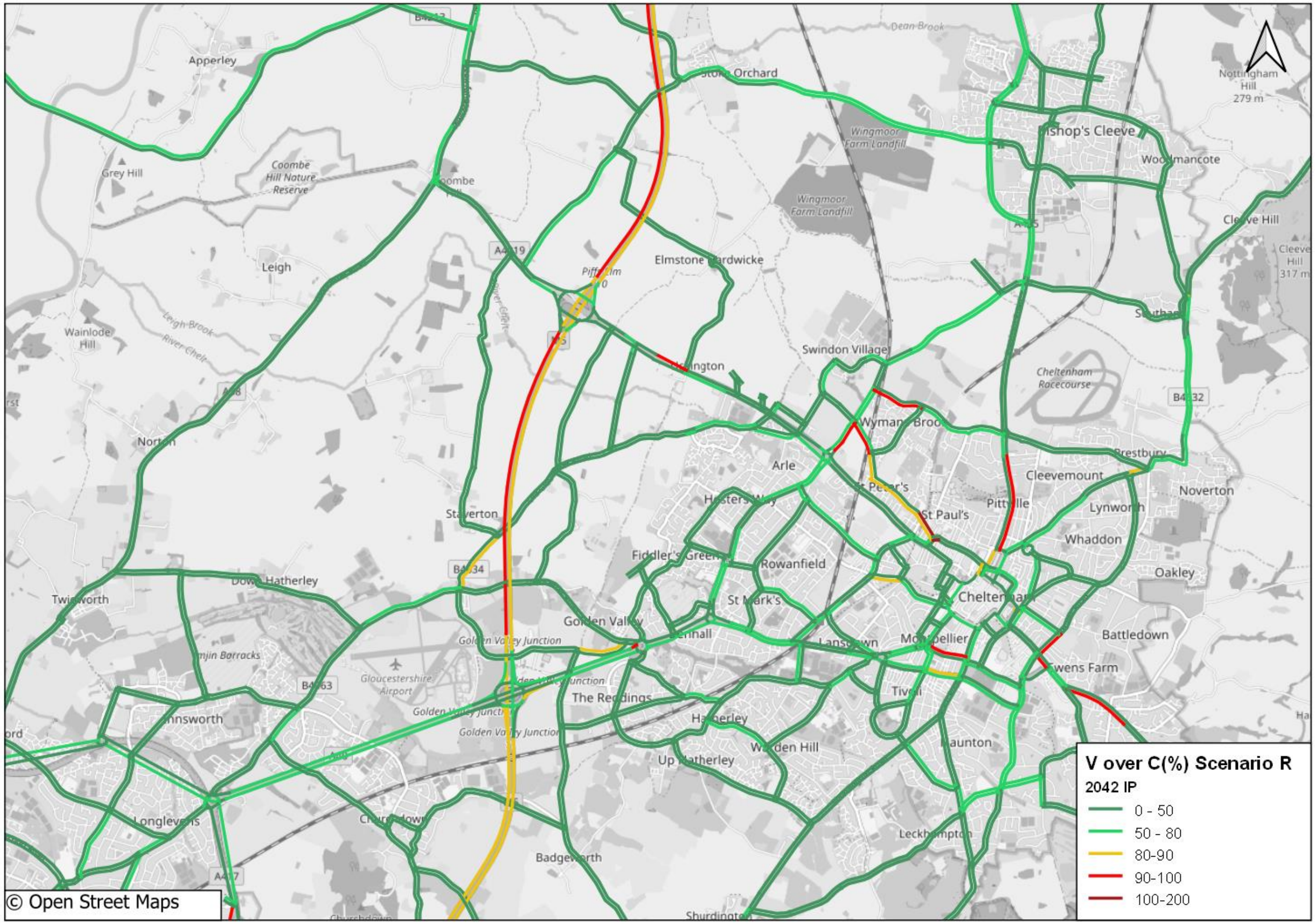


Figure 6-18 – Scenario R 2042 IP peak V/C in scheme area

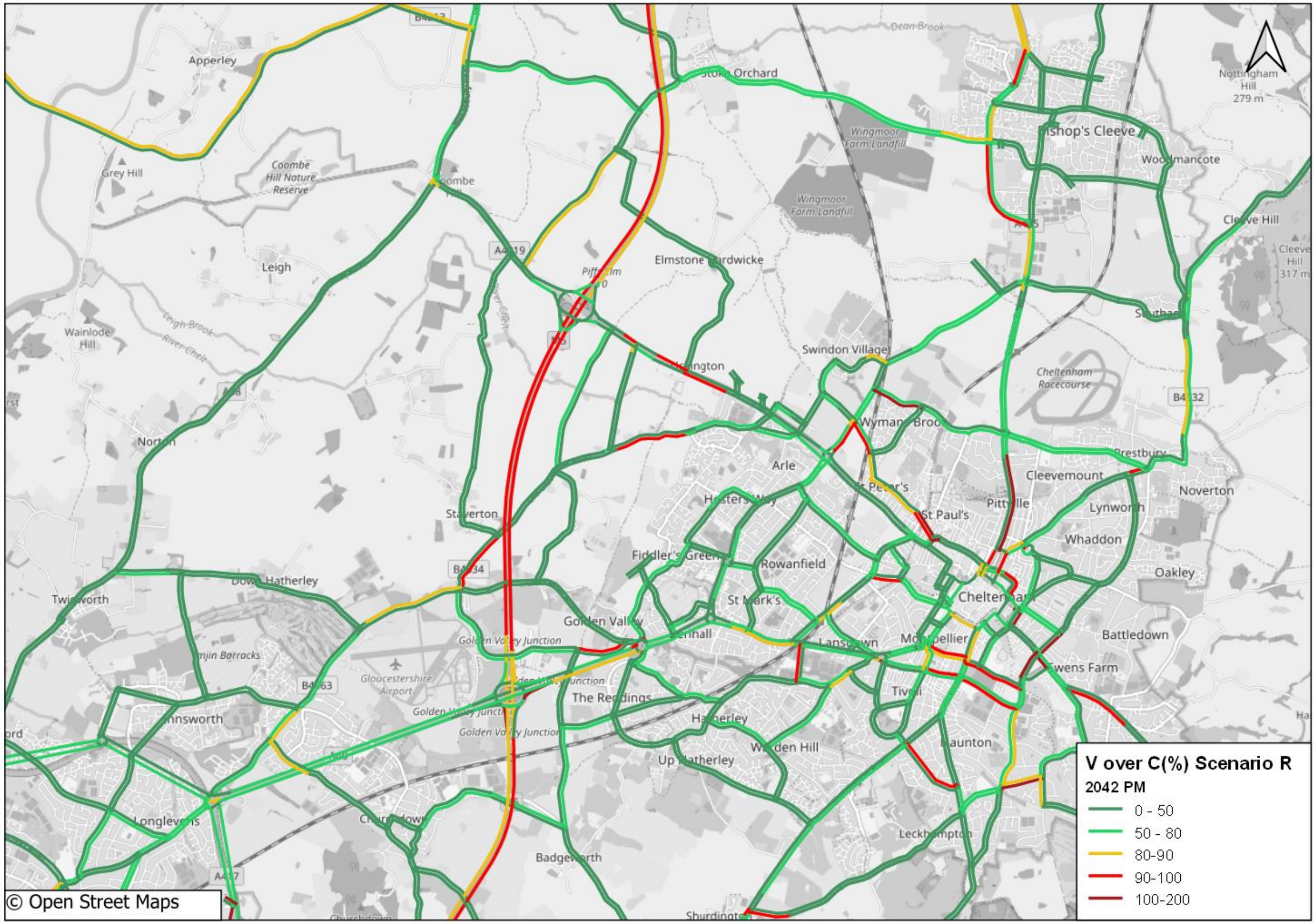


Figure 6-19 – Scenario R 2042 PM peak V/C in scheme area

7. Sensitivity Tests and Traffic Model Outputs to Other Work Streams

7.1. Overview

7.1.1. This chapter presents the results of the sensitivity scenarios (High and Low Growth) developed using forecasts based on the fixed matrix assignments for scenarios P, Q, R and S where:

- Scenarios Q and R include demand generated by all developments with the former (Q) excluding the proposed transport (DCO) scheme and the latter (R) includes the proposed transport (DCO) scheme.
- Scenarios P and S exclude the demand from the dependent development with the former (P) excluding the proposed transport (DCO) scheme and the latter (S) including the proposed transport (DCO) scheme.

7.1.2. Analysis of the traffic impacts focuses on the following comparisons between the scenarios:

- Overall assignment statistics across the model forecast years;
- Analysis of the change in traffic flows in sensitivity tests compared against the scenario R which includes demand generated by all developments and the proposed transport (DCO) scheme;
- Additional model output produced to help economics, design and environment teams;

7.2. Sensitivity Tests

7.2.1. The Core Scenario which uses central traffic growth is used as the basis of decision-making for the viability of the scheme. However, there is no guarantee that the traffic outturn will match the predicted growth. As a result, sensitivity tests are undertaken to check the effects of the scheme for the low and high demand assumptions as recommended by TAG.

Derivation of low and high growth matrices

7.2.2. In accordance with TAG Unit M4 on Forecasting and Uncertainty, the Low and High growth traffic forecasts should be based on a proportion of base year demand added to or taken away from the demand for the Core Scenario. The proportion of base year demand to be added or subtracted is based on a parameter p which varies by mode. The proportion is calculated as follows:

- for 1 year after the base year, proportion p of base year demand added to or subtracted from the Core Scenario;
- for 36 or more years after the base year, proportion 6*p of base year demand added to or subtracted from the Core Scenario; and
- between 1 and 36 years after the base year, the proportion of base year demand should rise from p to 6*p in proportion with the square root of the years. (So, for example, 16 years after the base year the proportion is 4*p).
- For highway demand at the national level, the recommended value of p is 4%. This reflects uncertainty around annual forecasts from NTEM, based on the macro-economic variables that influence the main drivers of travel demand. The matrix totals for low and high growth scenarios in comparison with the Core Scenario (Scenario R) is presented in Table 30, Table 31 and Table 32.

COVID-19 Impact

7.2.3. The current version of traffic model for M5 J10 was completed in the winter of 2023 whilst the guidance on assessing the impact of COVID-19 on travel and traffic patterns was published by DfT as part of the new "*TAG Unit M4 Forecasting and Uncertainty*" in May 2023. The new guidance states that "*the overall volumes of travel for most modes are still below pre-pandemic levels*". It also cites that "*there are a multitude of drivers of behaviour and demand; it is difficult to isolate the individual impact of COVID-19 and the extent to which impacts will be sustained long term is unclear*".

7.2.4. DfT believes that there is evident suppression of travel demand relative to a pre-pandemic projection of demand and recommends an appropriate and proportionate representation of its impact in the transport analysis. However, the Department recommend that the models should continue to be developed using the growth factors from the National Trip End Model data set (NTEM) to grow demand from their base year. The guidance whilst acknowledging the changes in household trip rates due to COVID-19, maintains that the growth rates contained in the NTEM should remain robust, as they continue to be in-line with official socio-economic projections.

7.2.5. The current M5 J10 modelling system presented in this report includes a core or central case scenario as well as low and high growth scenarios developed around the core in accordance with the same guidance (*TAG Unit M4 Forecasting and Uncertainty*). Given that the guidance for COVID-19 acknowledges lower levels of current and future travel demand, the results of low growth scenario (as presented in this report) can be considered an appropriate and proportionate representation of the impact of COVID-19 on travel volumes in the M5 J10 study area. Further traffic modelling updates and sensitivity tests are anticipated during PCF Stage 4 and likely to include a specific assessment on COVID-19 impacts.

Table 30 – Matrix Total Comparison for Core High and Low (Scenario R) 2027 – Including Intra-Zonal Trips

Time Period	Base	Growth (% age of Base)	Growth	2027 Core	2027 High	2027 Low
AM	5,405,768	13.90%	751,402	6,010,801	6,762,203	5,259,405
IP	4,884,778	13.90%	678,984	5,464,031	6,143,015	4,785,053
PM	6,057,249	13.90%	841,958	6,726,883	7,568,841	5,884,932

Table 31 – Matrix Total Comparison for Core High and Low (Scenario R) 2034– Including Intra-Zonal

Time Period	Base	Growth (% age of Base)	Growth	2034 Core	2034 High	2034 Low
AM	5,405,768	17.40%	940,604	6,242,130	7,182,734	5,301,533
IP	4,884,778	17.40%	849,952	5,685,644	6,535,595	4,835,701
PM	6,057,249	17.40%	1,053,961	7,000,080	8,054,041	5,946,127

Table 32 – Matrix Total Comparison for Core High and Low (Scenario R) 2042– Including Intra-Zonal

Time Period	Base	Growth (% age of Base)	Growth	2042 Core	2042 High	2042 Low
AM	5,405,768	20.80%	1,124,400	6,496,576	7,620,976	5,372,184
IP	4,884,778	20.80%	1,016,034	5,927,678	6,943,712	4,911,654
PM	6,057,249	20.80%	1,259,908	7,279,099	8,539,007	6,019,201

7.3. Overall Assignment Statistics

7.3.1. Key summary statistics for each of the model scenarios have been analysed to understand the overall differences between different scenarios and as a general check in terms of the consistency between the various assignments. Summary statistics, focusing on the overall area of the model (Simulation + Buffer) for Scenarios P and R are presented for each modelled time period in Table 33 to Table 38.

7.3.2. Analysis of these statistics shows that:

- All future year high growth scenarios demonstrate incremental increases in both total travel time and distances from the 2015 base model year to the 2027, 2034 and 2042 forecasts during each time period. This is to be expected given the scale of development added over core scenario;
- High level of convergence is achieved across all modelled scenarios. Except 2034 IP high growth scenario, all other models achieved convergence well within 60 loops. Though 2034 IP high growth did not satisfy the convergence criteria, the statistics show that assignment is very stable.
- Consistent increase in trips loaded between core and high, and reduction for low scenario can be seen across time periods and scenarios;
- Average Journey speeds for the network are almost similar in all scenarios and time periods ranging from 68 kmph to 73 kmph.

Table 33 – AM peak period assignment summary statistics for Core High and Low (Scenario P)

Statistic	Base	2027			2034			2042		
		Core	High	Low	Core	High	Low	Core	High	Low
Total Assigned Trips (PCUs in 000s)	1,799	1,999	2,249	1,749	2,130	2,443	1,817	2,294	2,668	1,919
Total Travel Time (PCU-hrs in 000s)	1,361	1,554	1,754	1,356	1,697	1,949	1,449	1,889	2,193	1,591
Travel Distance (PCU-kms in 000s)	95,236	105,356	118,627	92,096	115,442	132,053	98,824	128,929	148,796	109,053
Average Journey Speed (kph)	70.0	67.8	67.6	67.9	68	67.7	68.2	68.3	67.9	68.6
Loops (N)	29.0	32	63	29	33	47	23	35	65	24
%Flows	99.5	99.6	99.9	99.7	99.6	99.7	99.5	99.7	99.6	99.9
%Delays	99.8	99.5	99.4	99.8	99.5	99.1	99.8	99.5	99.2	99.9

Note : Scenario P excludes the demand from the depend development and also excludes the proposed transport (DCO) scheme

Table 34 – AM peak Period Assignment Summary Statistics for Core High and Low (Scenario R)

Statistic	Base	2027			2034			2042		
		Core	High	Low	Core	High	Low	Core	High	Low
Total Assigned Trips (PCUs in 000s)	1,799	1,999	2,156	1,843	2,132	2,445	1,819	2,298	2,672	1,923
Total Travel Time (PCU-hrs in 000s)	1,361	1,554	1,679	1,430	1,698	1,951	1,450	1,890	2,195	1,592
Travel Distance (PCU-kms in 000s)	95,236	105,365	113,674	97,065	115,482	132,093	98,864	128,992	148,861	109,116
Average Journey Speed (kph)	70.0	67.8	67.7	67.9	68	67.7	68.2	68.2	67.8	68.5
Loops (N)	29.0	34	46	33	32	59	26	41	51	21
%Flows	99.5	99.8	99.9	99.5	99.8	99.6	99.7	99.7	99.6	99.6
%Delays	99.8	99.6	99.5	99.7	99.5	99.2	99.9	99.6	98.4	99.8

Note : Scenario R includes the demand from all developments and also includes the proposed transport (DCO) scheme

Table 35 – IP Peak Period Assignment Summary Statistics for Core High and Low (Scenario P)

Statistic	Base	2027			2034			2042		
		Core	High	Low	Core	High	Low	Core	High	Low
Total Assigned Trips (PCUs in 000s)	1,385	1,549	1,741	1,356	1,665	1,906	1,424	1,813	2,101	1,525
Total Travel Time (PCU-hrs in 000s)	971	1,122	1,265	980	1,240	1,420	1,062	1,404	1,621	1,191
Travel Distance (PCU-kms in 000s)	73,093	81,283	91,466	71,100	90,188	102,949	77,431	102,476	117,734	87,212
Average Journey Speed (kph)	75.3	72.4	72.3	72.5	72.7	72.5	72.9	73	72.6	73.2
Loops (N)	15.0	24	28	15	19	38	14	19	41	15
%Flows	99.9	99.9	99.5	99.8	100	99.6	99.9	99.8	99.9	99.7
%Delays	99.9	99.9	99.6	99.9	100	99.6	99.9	99.8	99.7	99.9

Note : Scenario P excludes the demand from the depend development and also excludes the proposed transport (DCO) scheme

Table 36 – IP Peak Period Assignment Summary Statistics for Core High and Low (Scenario R)

Statistic	Base	2027			2034			2042		
		Core	High	Low	Core	High	Low	Core	High	Low
Total Assigned Trips (PCUs in 000s)	1,385	1,549	1,742	1,356	1,667	1,908	1,426	1,816	2,104	1,528
Total Travel Time (PCU-hrs in 000s)	971	1,122	1,265	980	1,241	1,421	1,063	1,406	1,622	1,192
Travel Distance (PCU-kms in 000s)	73,093	81,290	91,473	71,106	90,217	102,978	77,460	102,524	117,784	87,261
Average Journey Speed (kph)	75.3	72.4	72.3	72.5	72.7	72.5	72.9	72.9	72.6	73.2
Loops (N)	15.0	21	24	15	16	100	15	18	30	15
%Flows	99.9	99.9	99.7	99.8	99.9	99.3	99.9	99.8	99.8	99.8
%Delays	99.9	99.9	99.7	99.9	99.9	99.5	99.9	99.8	99.3	99.9

Note : Scenario R includes the demand from all developments and also includes the proposed transport (DCO) scheme

Table 37 – PM Peak Period Assignment Summary Statistics for Core High and Low (Scenario P)

Statistic	Base	2027			2034			2042		
		Core	High	Low	Core	High	Low	Core	High	Low
Total Assigned Trips (PCUs in 000s)	1,833	2,035	2,290	1,780	2,183	2,502	1,864	2,368	2,749	1,987
Total Travel Time (PCU-hrs in 000s)	1,306	1,495	1,687	1,305	1,649	1,891	1,410	1,858	2,150	1,571
Travel Distance (PCU-kms in 000s)	92,231	101,987	114,836	89,151	112,949	129,043	96,862	127,757	147,016	108,513
Average Journey Speed (kph)	70.6	68.2	68.1	68.3	68.5	68.2	68.7	68.8	68.4	69.1
Loops (N)	26.0	39	43	27	40	48	23	33	41	21
%Flows	99.7	99.7	99.8	99.8	99.7	99.9	99.9	99.6	99.6	99.8
%Delays	99.6	99.5	99.3	99.8	99.7	99.5	99.8	99.3	98.8	99.9

Note : Scenario P excludes the demand from the depend development and also excludes the proposed transport (DCO) scheme

Table 38 – PM Peak Period Assignment Summary Statistics for Core High and Low (Scenario R)

Statistic	Base	2027			2034			2042		
		Core	High	Low	Core	High	Low	Core	High	Low
Total Assigned Trips (PCUs in 000s)	1,833	2,035	2,290	1,780	2,185	2,504	1,867	2,372	2,753	1,990
Total Travel Time (PCU-hrs in 000s)	1,306	1,495	1,687	1,305	1,650	1,893	1,411	1,860	2,153	1,572
Travel Distance (PCU-kms in 000s)	92,231	101,995	114,844	89,160	112,986	129,083	96,901	127,820	147,084	108,577
Average Journey Speed (kph)	70.6	68.2	68.1	68.3	68.5	68.2	68.7	68.7	68.3	69.1
Loops (N)	26.0	40	34	22	34	49	22	32	44	23
%Flows	99.7	99.6	99.7	99.8	99.6	99.9	99.7	99.6	99.7	99.7
%Delays	99.6	99.5	99.1	99.8	99.2	99.6	99.7	99.3	98.7	99.8

Note : Scenario R includes the demand from all developments and also includes the proposed transport (DCO) scheme

7.4. Flow Difference Analysis

7.4.1. The effects of the demand from the low and high growth demand scenarios are examined to study the traffic flow patterns on M5J10, A4019 and surrounding local and strategic road network.

7.4.2. Analysis undertaken to understand these changes in traffic patterns includes:

- Flow difference analysis across Scenarios P and R for core, high and low 2042 AM Peak, IP and PM Peak time period in the core study area.

7.4.3. Modelled flow difference patterns for all links in the core study area are shown below to provide an idea of the overall changes in traffic levels.

7.4.4. Figure 7-1 to Figure 7-6 shows the flow difference plots for scenario R which includes the demand from all developments and the proposed transport (DCO) scheme.

7.4.5. Figure 7-7 to Figure 7-12 shows the flow difference plots for Scenario P which excludes the demand from the dependent development and the proposed transport (DCO) scheme.

7.4.6. All flow difference plots are with reference to core. Therefore, negative bandwidth shows increase in flow compared to core scenario and positive bandwidth is indicative of decrease in flow compared to core scenario.

7.4.7. Trend across all scenarios is consistent for high and low growth scenarios. For 2042 on motorway reduction/addition is upto 600 vehicles compared to core outputs.

7.4.8. In R scenario, flow difference of not more than 200 vehicles was seen on A4019 in comparison to low and high growth for all time periods.

7.4.9. Similarly in P scenario, flow difference of not more than 200 vehicles was seen on A4019 in comparison to low and high growth for all time periods.

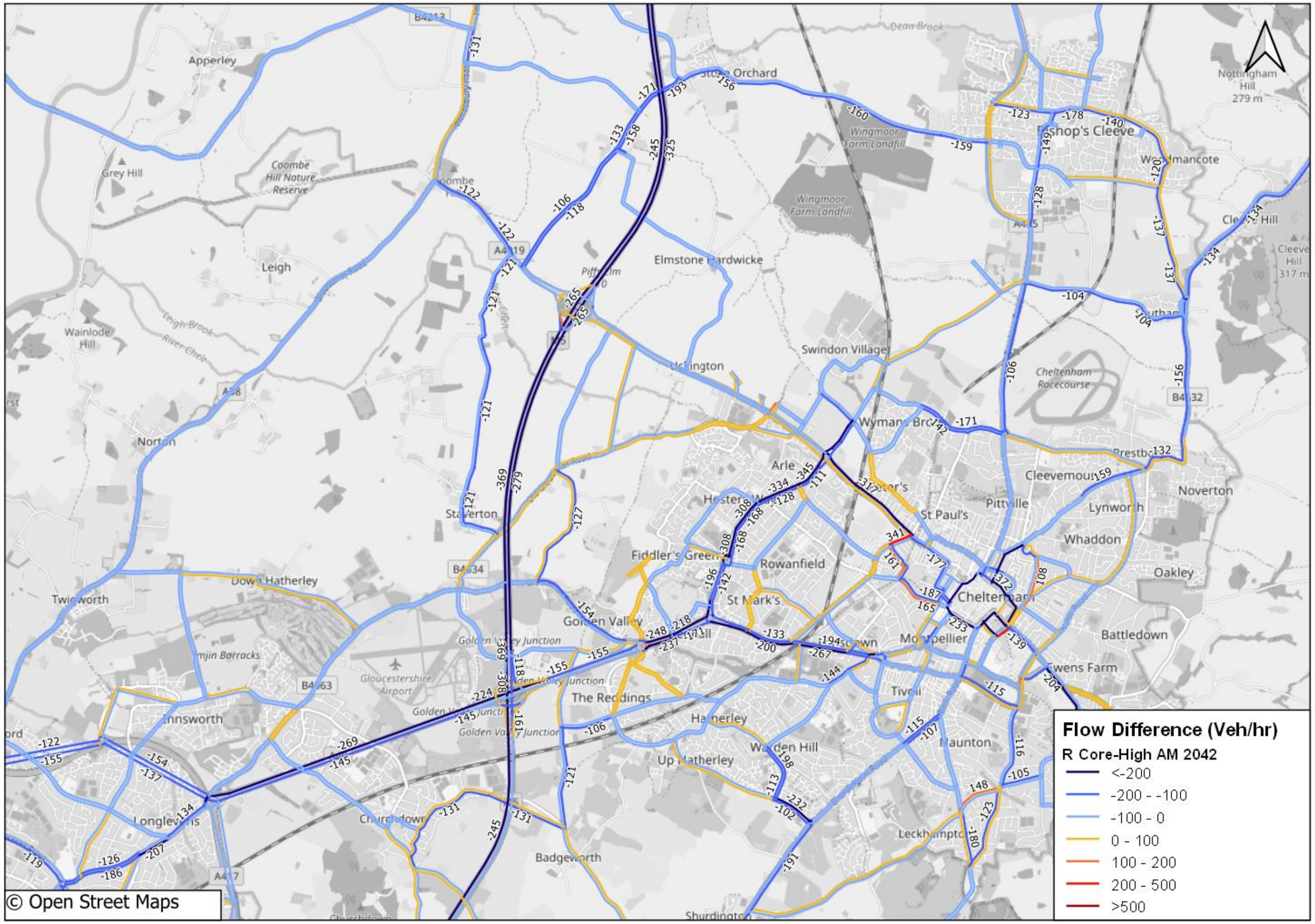


Figure 7-1 – Flow Difference – 2042 AM Peak : Core Scenario R v High Growth Scenario

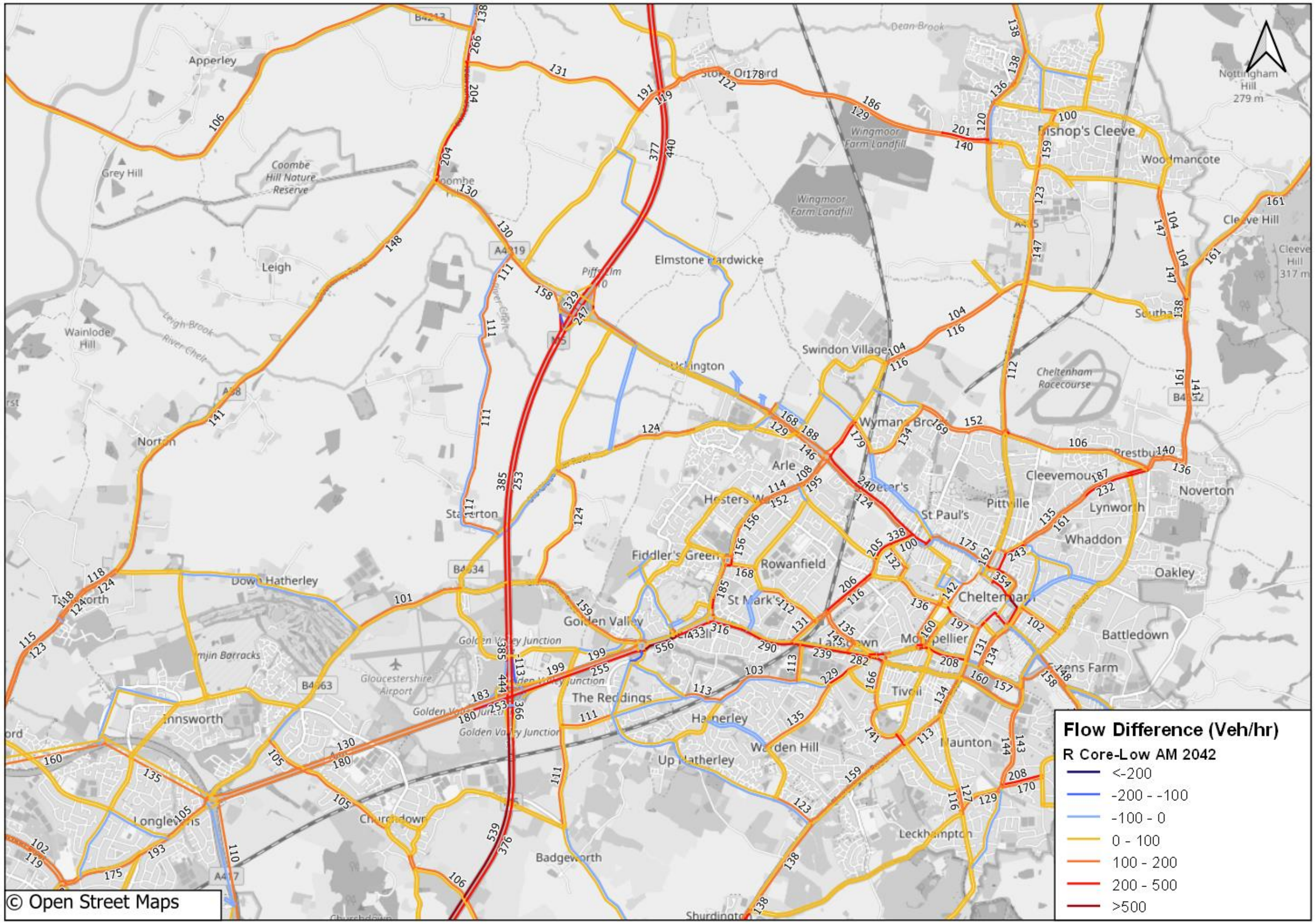


Figure 7-2 – Flow Difference – 2042 AM Peak : Core Scenario R v Low Growth

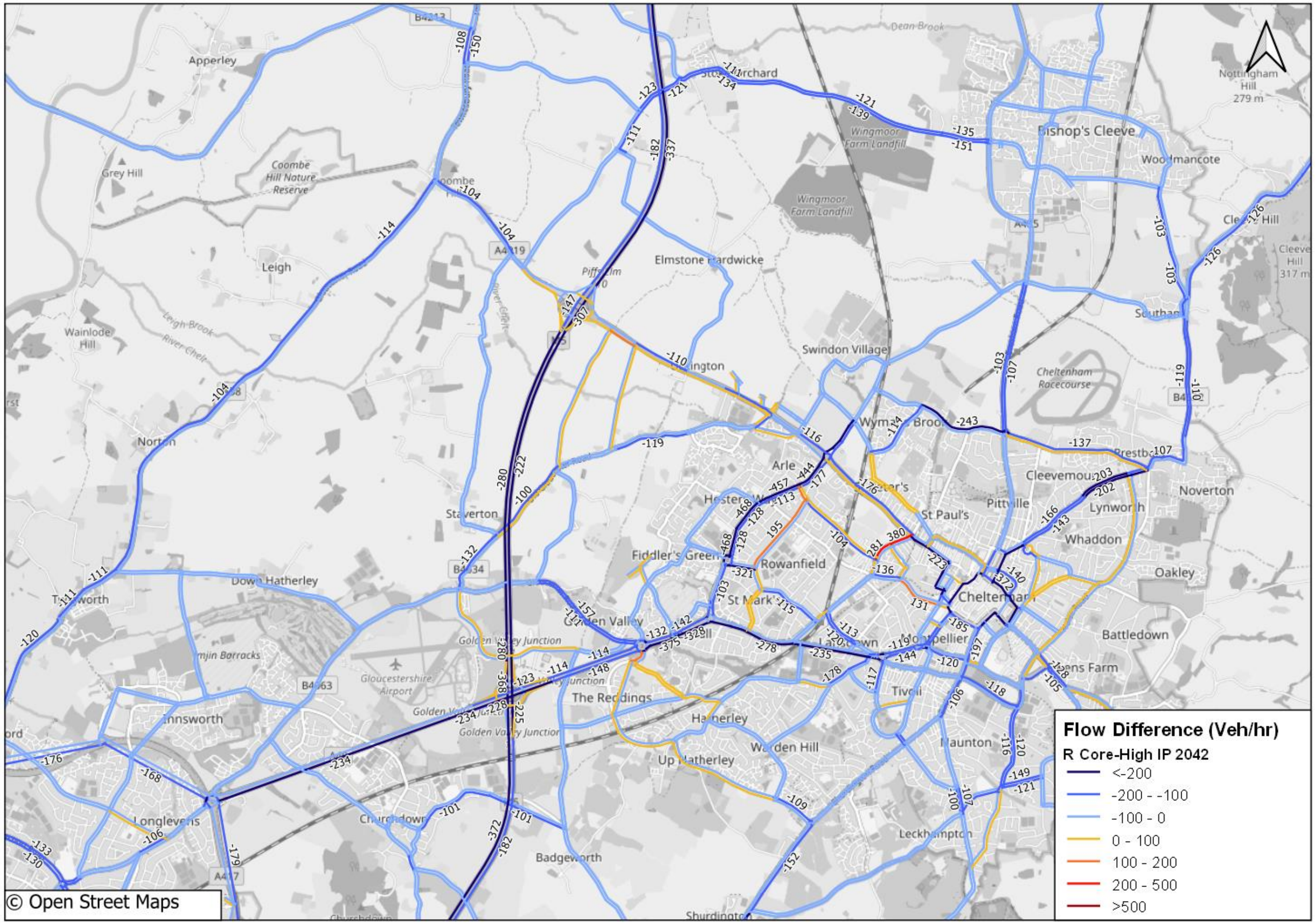


Figure 7-3 – Flow Difference - 2042 Inter Peak : Core Scenario R v High Growth Scenario

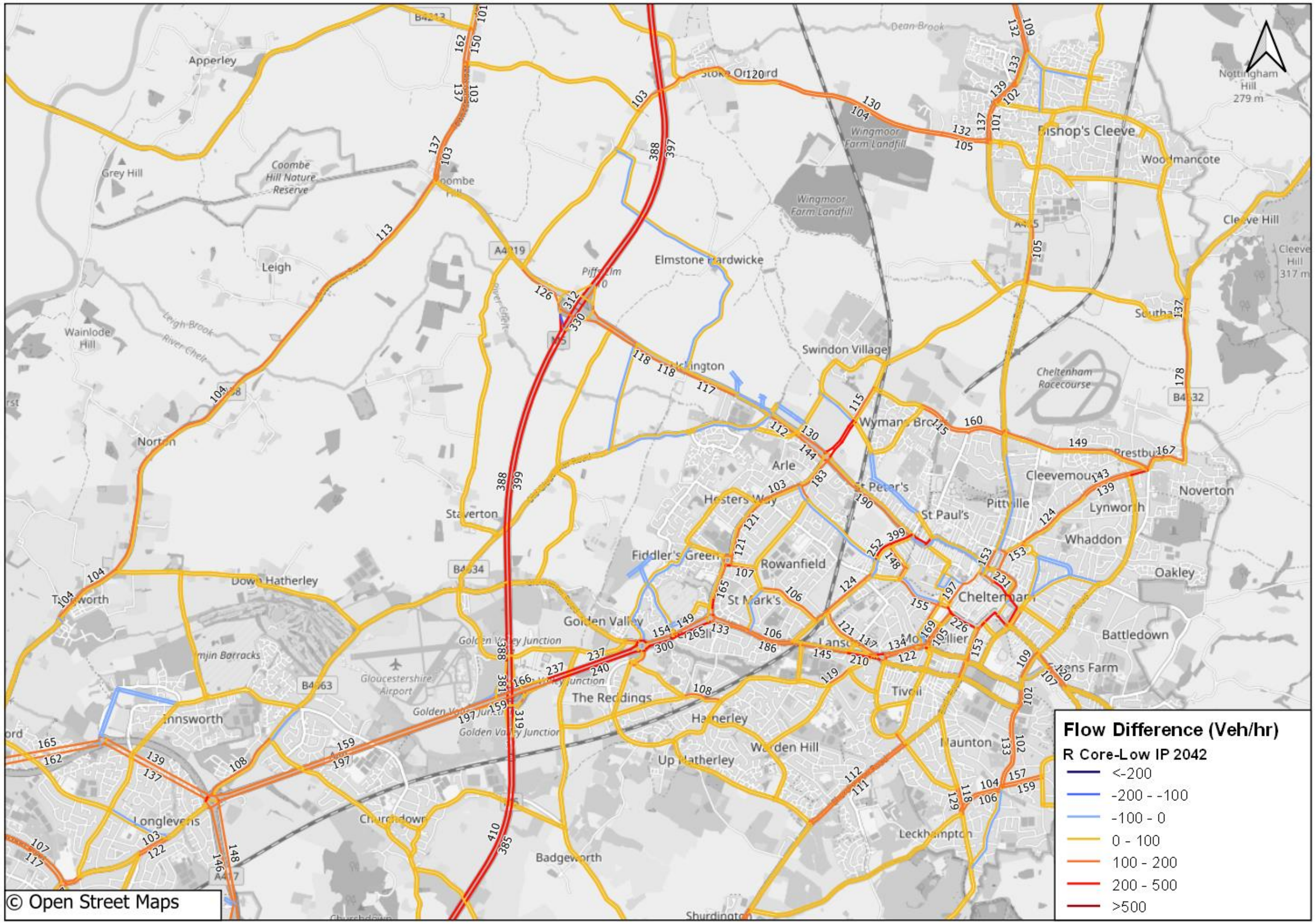


Figure 7-4 – Flow Difference - 2042 Inter Peak : Core Scenario R v Low Growth

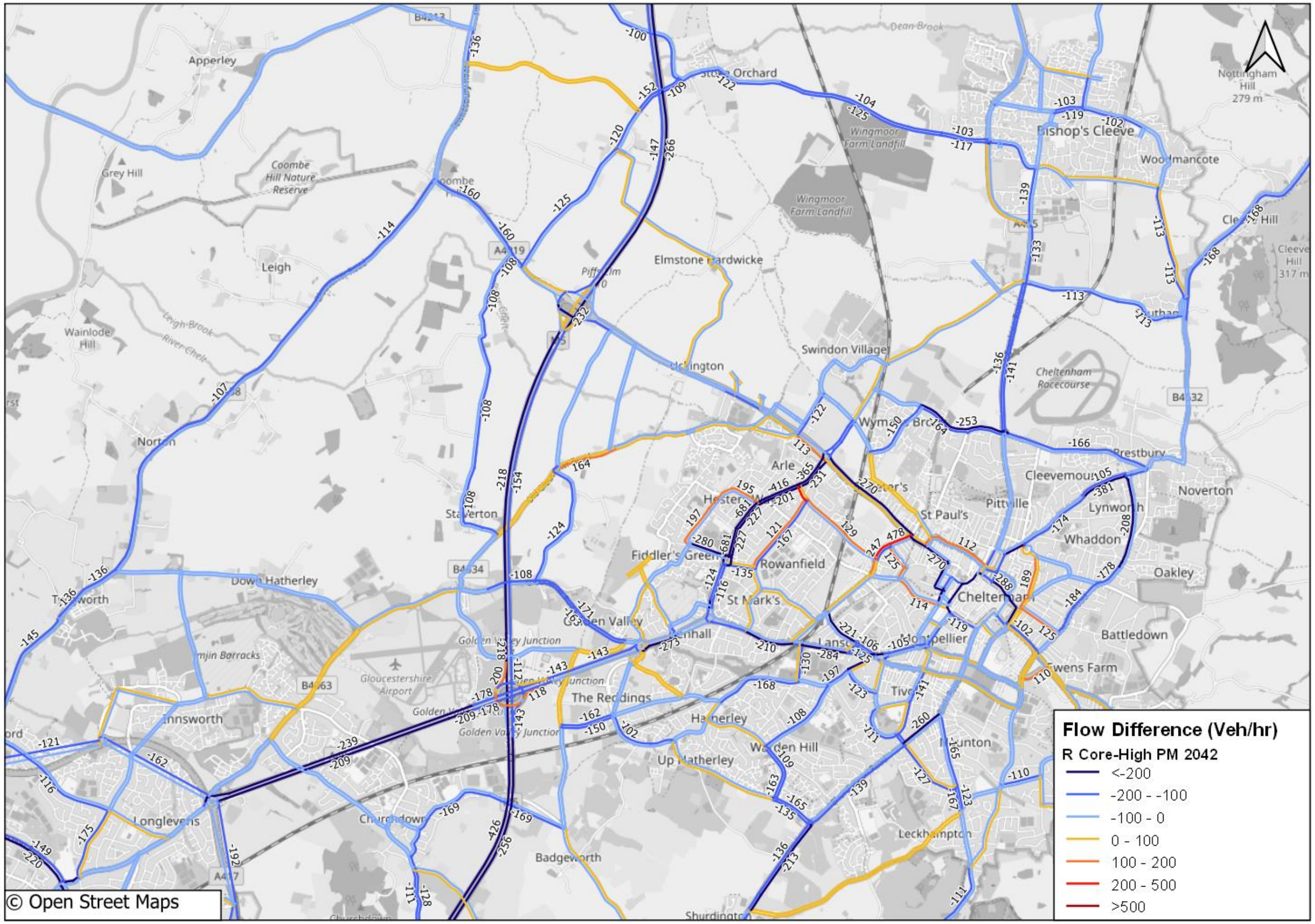


Figure 7-5 – Flow Difference - 2042 PM Peak : Core Scenario R v High Growth Scenario

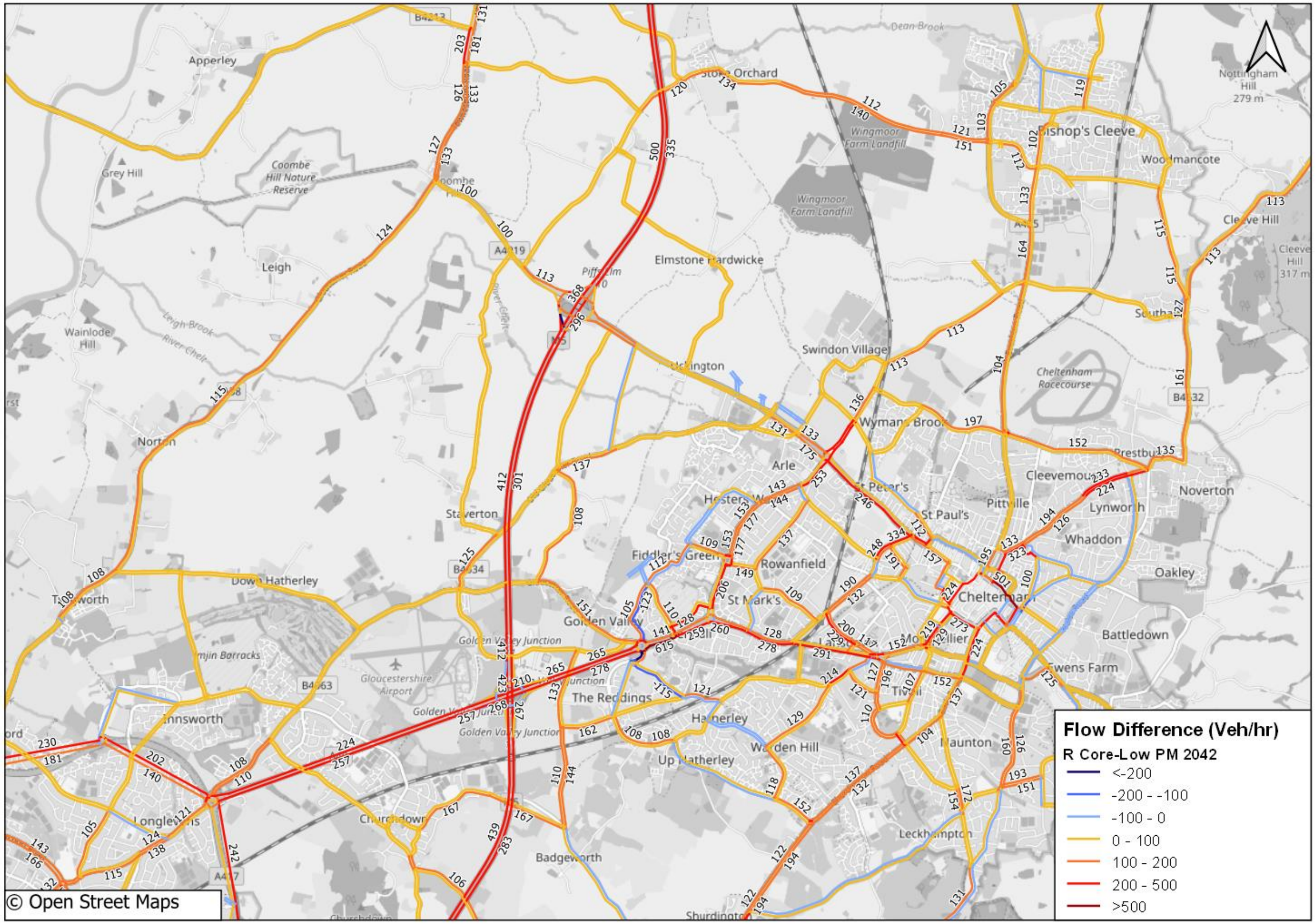


Figure 7-6 – Flow Difference - 2042 PM Peak : Core Scenario R v Low Growth

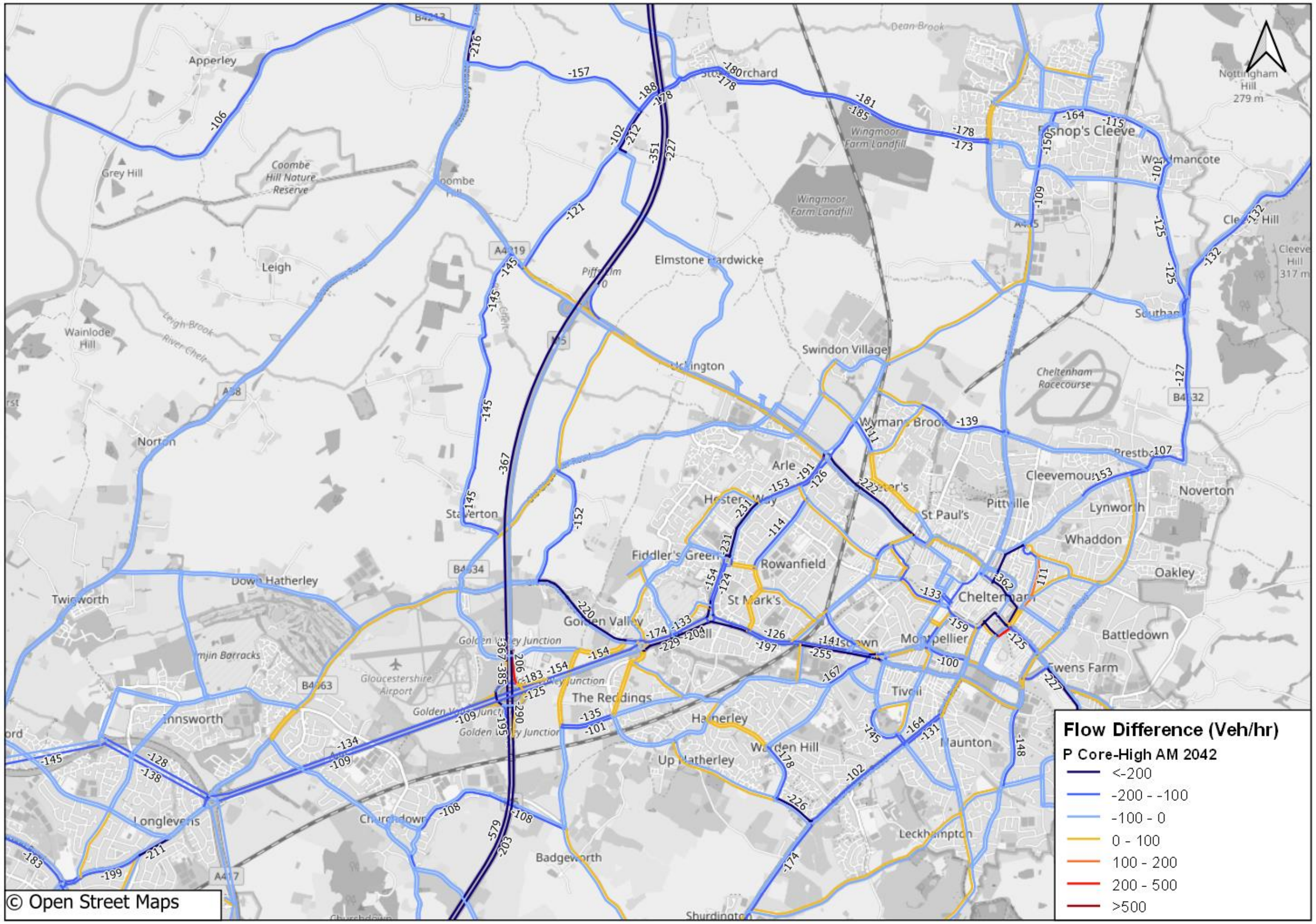


Figure 7-7 – Flow Difference - 2042 AM Peak : Core Scenario P v High Growth Scenario

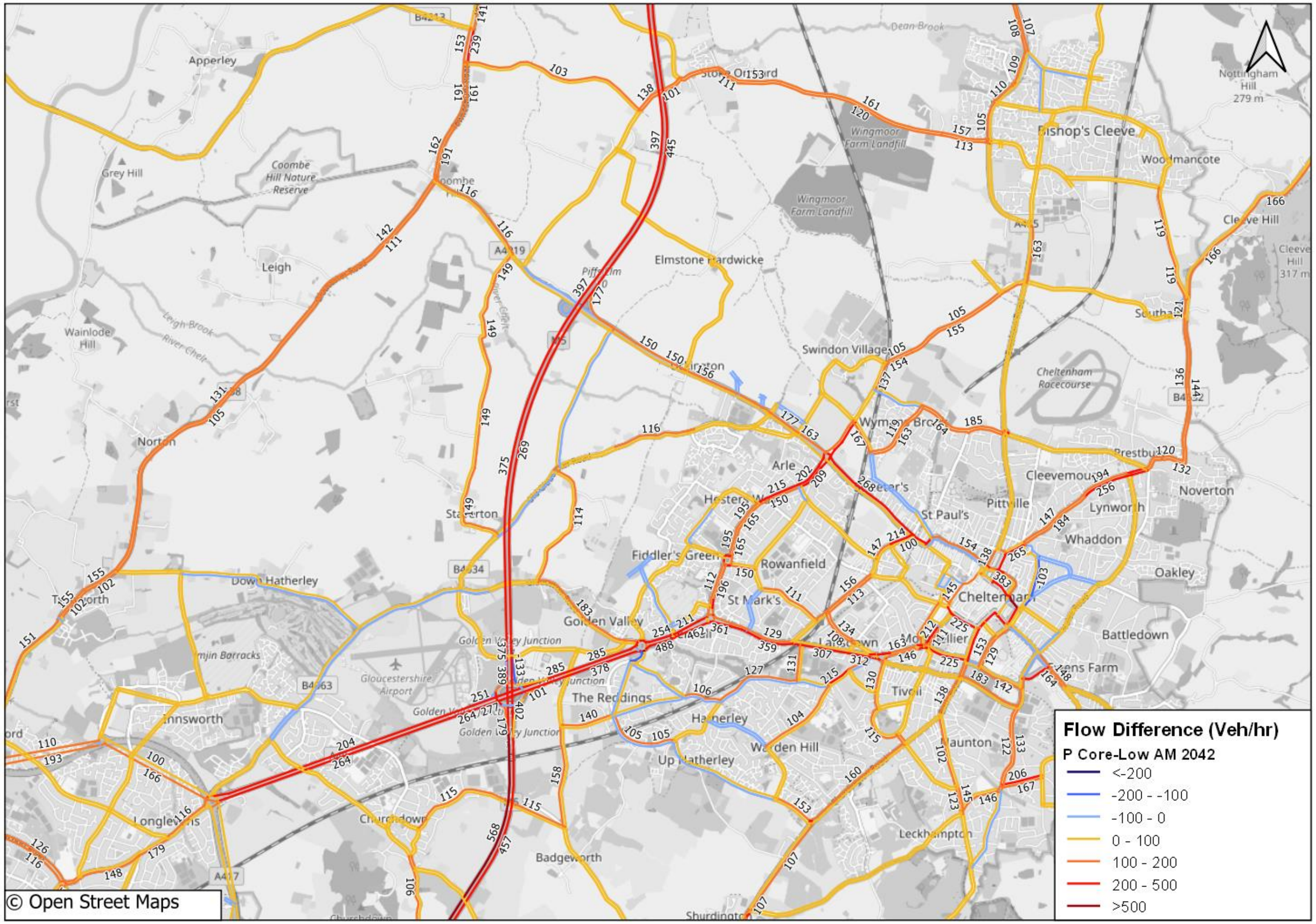


Figure 7-8 – Flow Difference - 2042 AM Peak : Core Scenario P v Low Growth

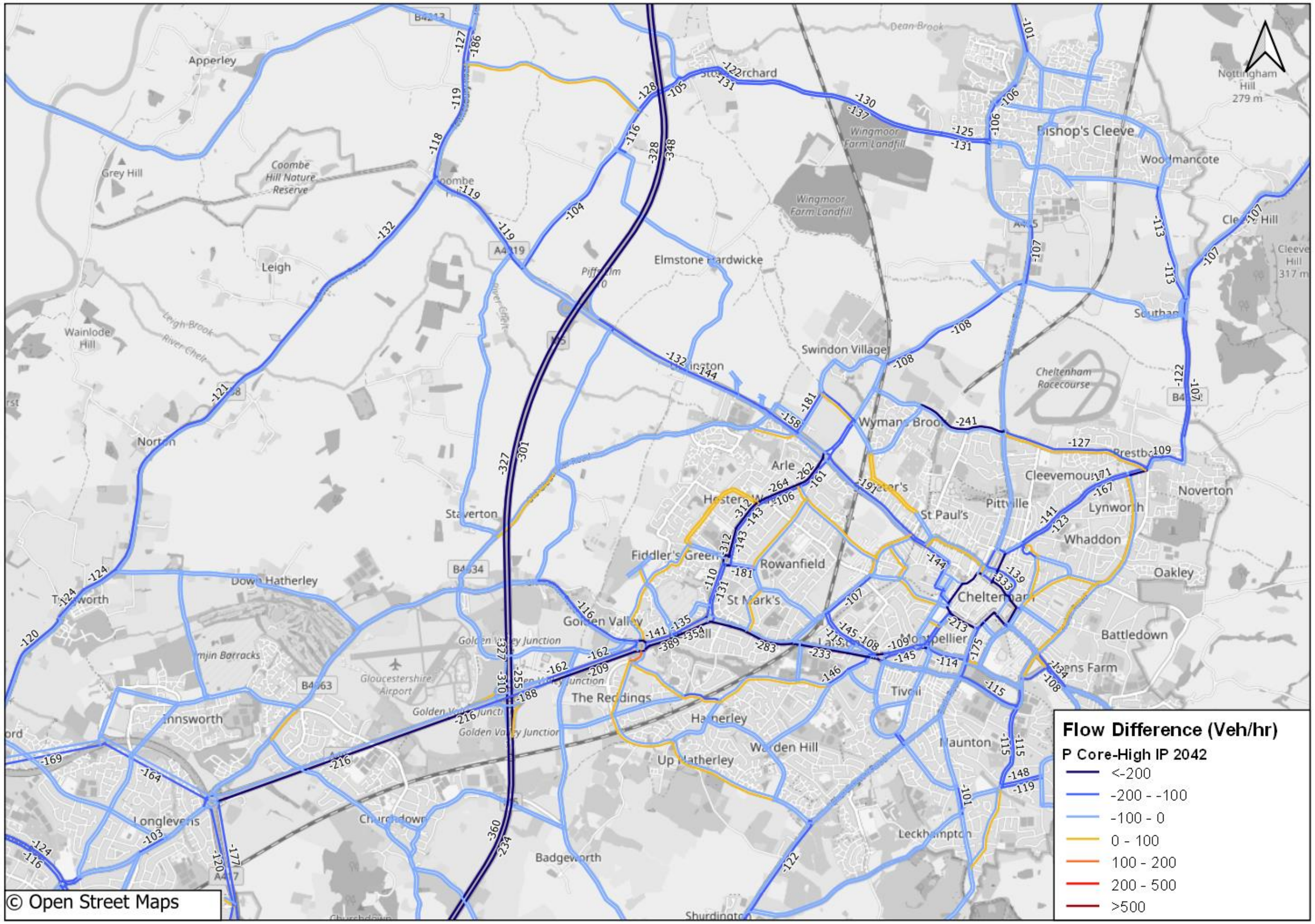


Figure 7-9 – Flow Difference - 2042 Inter Peak : Core Scenario P v High Growth Scenario

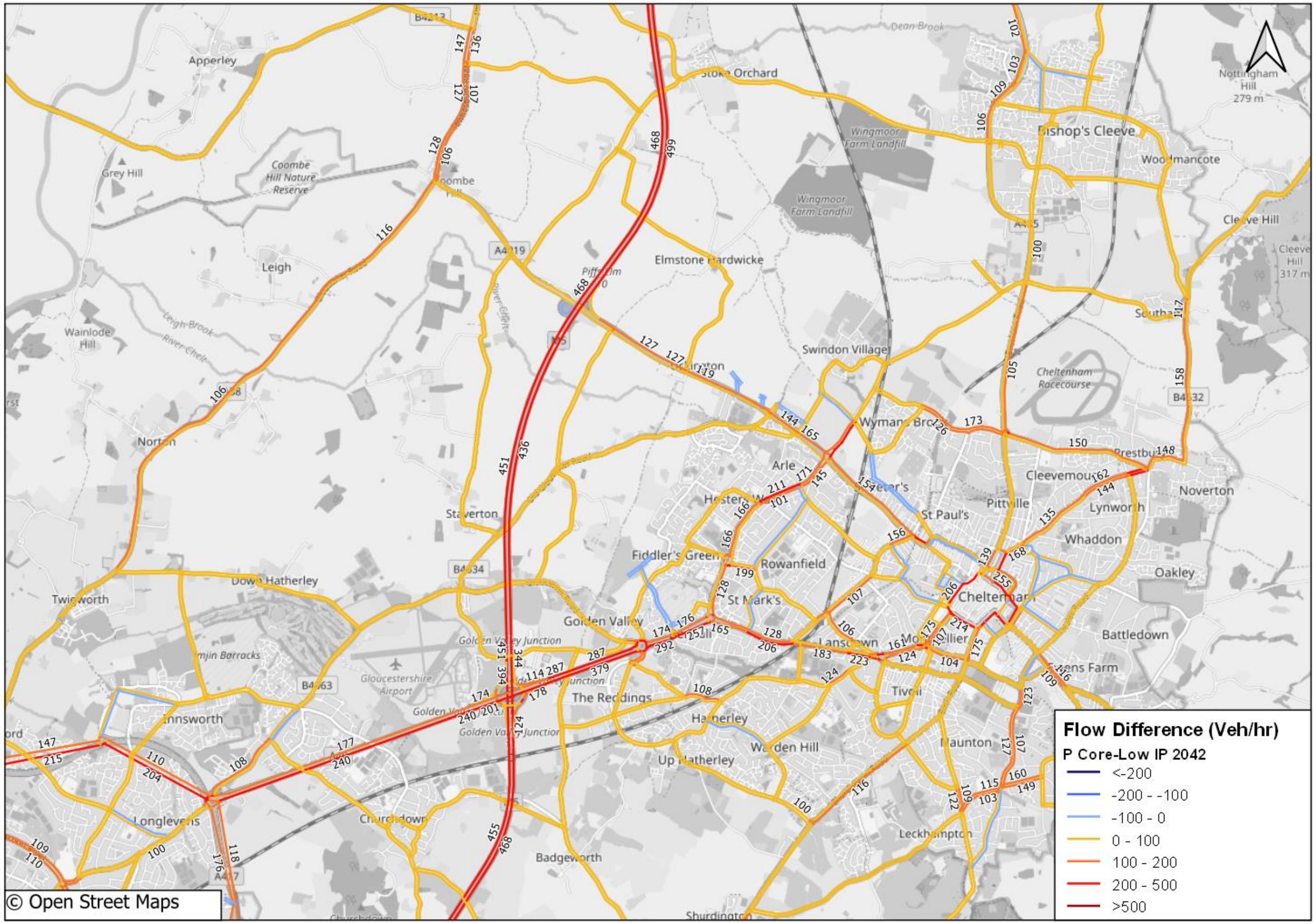


Figure 7-10 – Flow Difference - 2042 Inter Peak : Core Scenario P v Low Growth

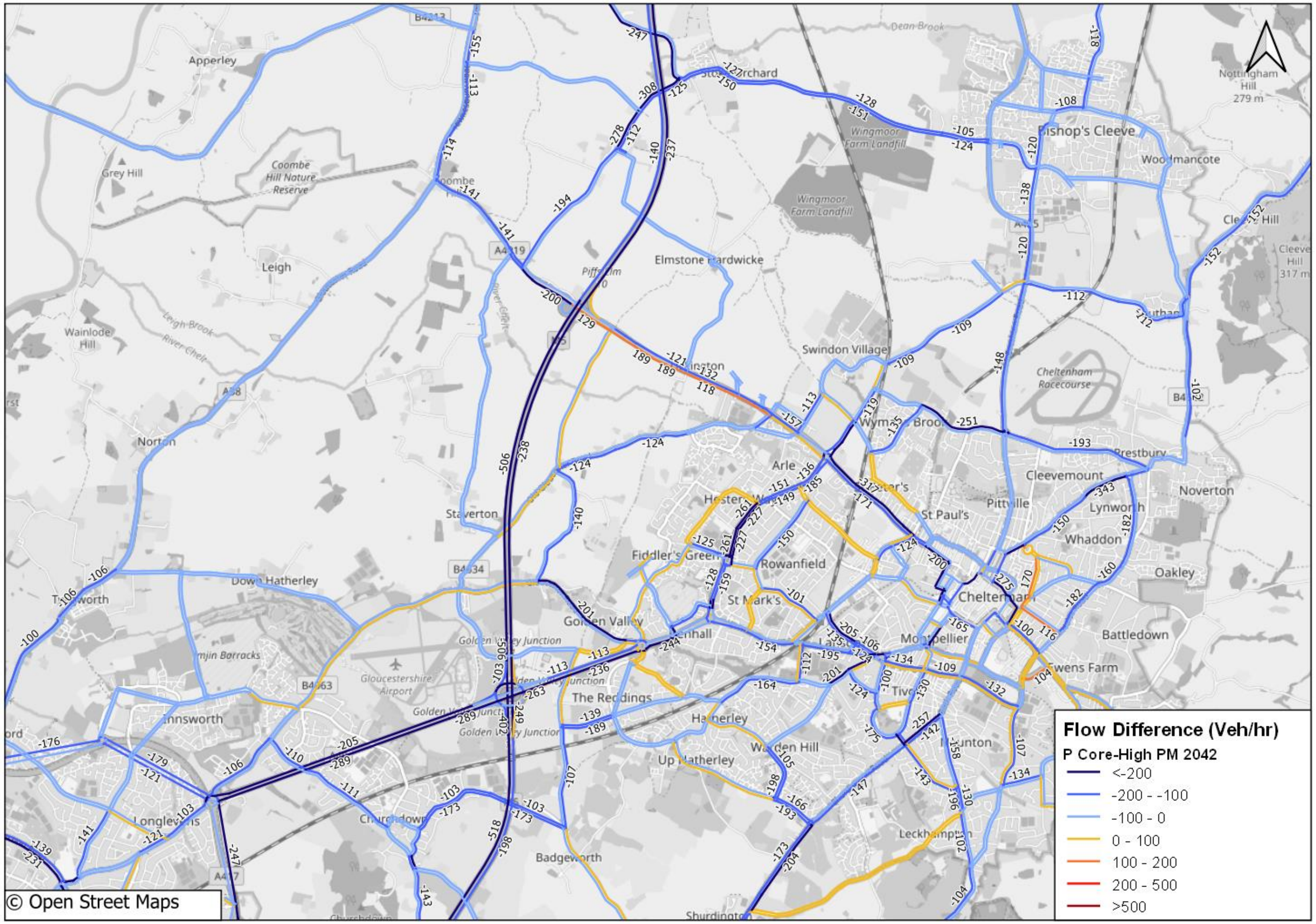


Figure 7-11 – Flow Difference - 2042 PM Peak : Core Scenario P v High Growth Scenario

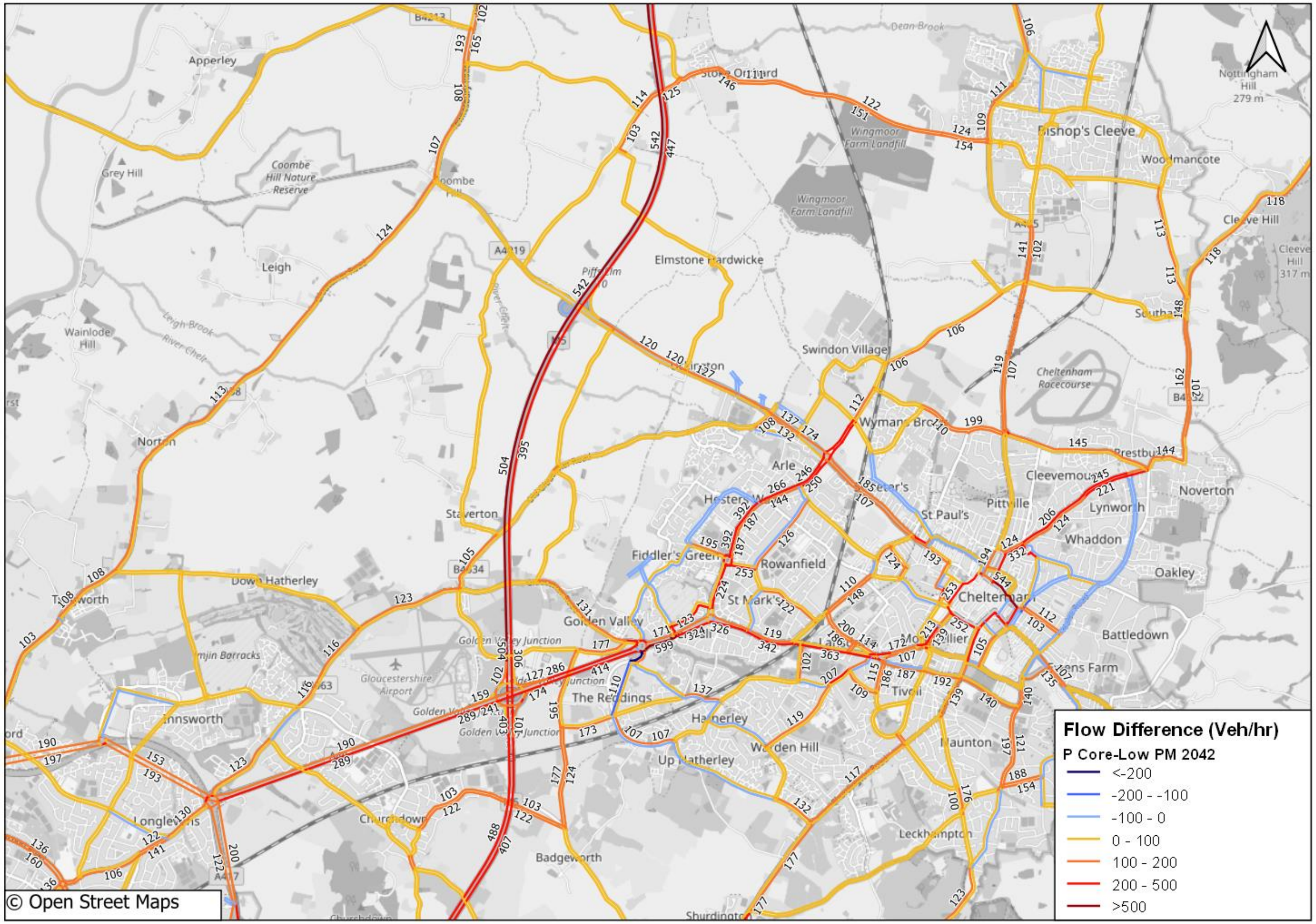


Figure 7-12 – Flow Difference - 2042 PM Peak : Core Scenario P v Low Growth Scenario

7.5. Further outputs

7.5.1. Traffic model outputs are required to support the economic, environmental assessments and various design elements. This section outlines the methodology and factors used to expand the three modelled peak period to 12 hour/16 hour/18 hour/24-hour Annual Average Weekday Traffic (AAWT) or Annual Average Daily Traffic (AADT) flows.

7.5.2. Additional model outputs have been produced to inform wider assessment work for scheme design and appraisal. This includes:

- Highway assignment demand, time, distance and toll/charge skims for the purposes of TUBA economic assessment;
- 24-hour AADT and 18-hour AAWT total flow, HGV flow and average speed data – for the purposes of environmental assessment within the Affected Road Network (ARN);
- 24-hour AADT and % HGV flow for the scheme and its immediate surrounding area for design teams.

Factors

7.5.3. AADT and AAWT factors were derived using WebTRIS counts for motorway and for A road / local road counts data provided by GCC. Table 39 and Table 40 shows the sites used to derive the AADT and AAWT factors for Motorway links and local links. Location of the sites on M5 and local roads are shown in Figure 7-13 and Figure 7-14 below.

7.5.4. As mentioned earlier the M5 J10 Stage3 model represents an average hour flow across the modelled time period. For the design purposes a worst peak hour was also established using the local road and WebTRIS count. These were used to derive the factors to convert the average peak hour traffic to worst peak hour traffic by road. Table 41 shows the expansion factors derived for all vehicles and heavy vehicles.

Table 39 – M5 Sites for Expansion Factor

Site Description	Location	Northing	Easting	Direction
MIDAS site at M5/7828B	South of J11, NB	389678	220942	Northbound
MIDAS site at M5/7828A	South of J11, SB	389696	220923	Southbound
MIDAS site at M5/7823B	North of J11, NB	389670	221449	Northbound
MIDAS site at M5/7821A	North of J11, SB	389685	221623	Southbound
MIDAS site at M5/7818B	Between J10-J11, NB	389661	221949	Northbound
MIDAS site at M5/7817A	Between J10-J11, SB	389678	222024	Southbound
MIDAS site at M5/7796A	Between J10-J11, SB	389793	224099	Southbound

Table 40 – Local Sites for Expansion Factor

Site_ID	Description	Direction
4004_N	A38 Coombe Hill	Northbound
4004_S	A38 Coombe Hill	Southbound
4005_N	Leigh of Coombe Hill	Northbound
4005_S	Leigh of Coombe Hill	Southbound
4038_E	Piffs Elm West of M5	Eastbound
4038_W	Piffs Elm West of M5	Westbound
5018_E	Ukington East of M5	Eastbound

Site_ID	Description	Direction
5018_W	Ukington East of M5	Westbound
4152_E	Cheltenham road, Staverton	Eastbound
4152_W	Cheltenham road, Staverton	Westbound
5038_E	Hayden Road Cheltenham	Eastbound
5038_W	Hayden Road Cheltenham	Westbound

Figure 7-13 – WebTRIS Sites on M5 for expansion factors

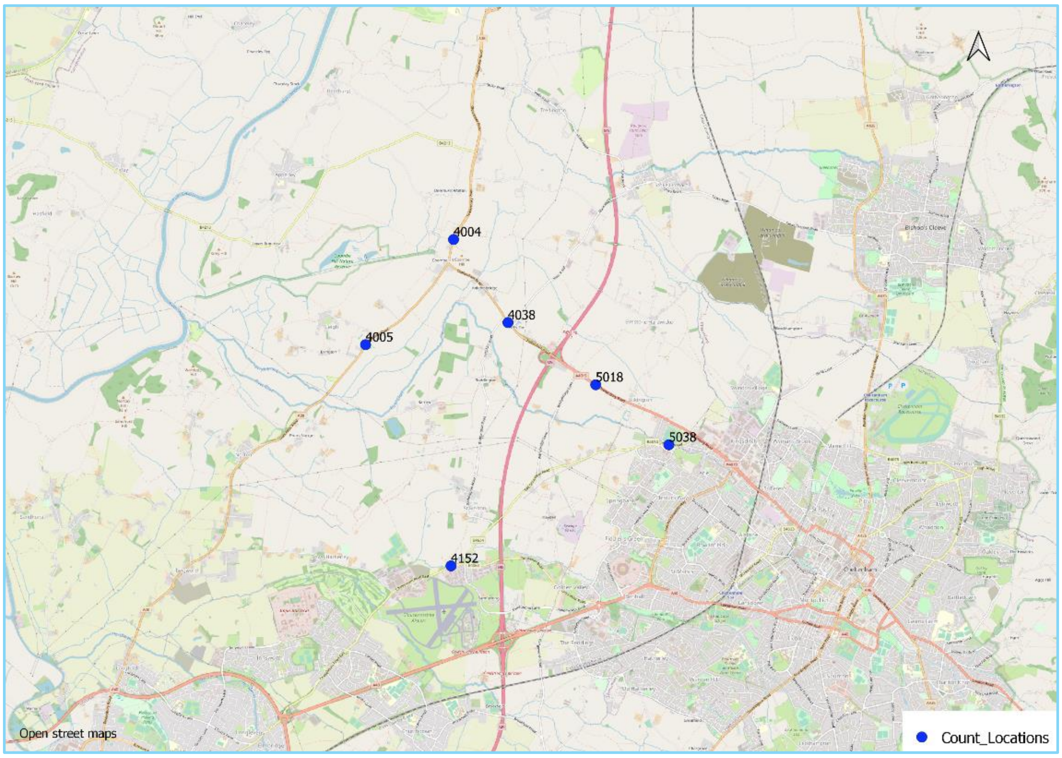


Figure 7-14 – Counts on Local Roads

Table 41 – Expansion Factors

Expansion factor type	Name	Factor for Motorway	Factor for Local Road
Peak Period to Worst peak hour (AM)	Worst Hour	1.14	1.11
Peak Period to Worst peak hour (PM)	Worst hour	1.12	1.10
12hr to 24hr	AAWT24	1.283	1.178
12hr to 18hr	AAWT18	1.213	1.158
6hr IP to 8hr night	AAWT8	0.290	0.220
24hr AAWT to 24hr AADT	AADT	0.953	0.906

Traffic Flow Data to Design Teams

7.5.5. Based on the factors derived, worst peak hour traffic AADTs and HGV% were plotted for the scheme and immediate surrounding area for 2042 P and R scenarios. These are presented in Appendix D.

Economics

7.5.6. Demand matrices as well as time and distance skim matrices for both Do-Minimum and Do-Something scenarios at all the forecast years under low, core and high growth scenario were produced for economic assessment. Details of annualization factors for economic assessment are provided in Economics Appraisal Package.

8. Conclusions

8.1. Overall Assignment Statistics

8.1.1. Incremental increase in both total travel time and distances from base model year to the forecast years is seen as expected during all time periods.

8.1.2. No significant changes were observed in network speeds across various scenario for respective forecast year and time period.

8.1.3. Assignment models have achieved convergence in line with TAG for all forecast years and scenarios. All models converged within 50 loops.

8.2. Traffic Analysis

8.2.1. With the new M5 J10 roundabout in place in scenario R, large increase in flows along the motorway between M5 J11 and M5 J10 is observed.

8.2.2. On provision of the new M5 J10 roundabout and the other elements of the proposed scheme the main parallel roads on both sides of the M5 motorway between J10 and J11 generally experiences a degree of reduction in their traffic flows.

8.2.3. A4019 being one of the approach arms to M5 J10 roundabout, has similar increase in flow as that of the motorway between M5 J10 and M5 J11.

8.2.4. In line with flow differences, scenario R demonstrate the clear reductions in delay on local routes and increase in delay on Motorway between M5 J10 and M5 J11 in both AM and PM peaks.

8.2.5. Due to the reduced flows and delays, slight reductions in V/C on local routes and increase in V/C on Motorway between M5 J10 and M5 J11 during both AM and PM time periods.

Appendices

Appendix A. M5 J10 Development Uncertainty Log

Table A1 : Residential sites

SATURN Zone No	Development name	District	Planning reference (if available)	No. dwellings	Certainty	In Core Scenario?	% Completion (2027)	% Completion (2034)	% Completion (2042)
90101	West Cheltenham JCS R (Cheltenham Cyber Park R)	Cheltenham	None	2,371	MTL	Yes	5%	32%	63%
90103	Haines And Strange Albion Street Cheltenham Gloucestershire GL52 2RH	Cheltenham	13/00827/OUT	50	NC	Yes	100%	0%	0%
90104	GCHQ Oakley Priors Road Cheltenham Gloucestershire GL52 5AJ	Cheltenham	13/01683/REM	311	NC	Yes	100%	0%	0%
90105	Car Park North Place Cheltenham Gloucestershire GL50 4DW	Cheltenham	12/01612/FUL	143	MTL	Yes	50%	50%	0%
90106	Central Cheltenham Police Station Talbot House Lansdown Road Cheltenham Gloucestershire GL51 6QT	Cheltenham	17/00337/FUL	67	NC	Yes	100%	0%	0%
90107	Cotswold Court Lansdown Road Cheltenham Gloucestershire GL50 2JA	Cheltenham	13/01501/FUL	53	NC	Yes	100%	0%	0%
90108	Land To Rear Of Nuffield Hospital Hatherley Lane Cheltenham Gloucestershire R	Cheltenham	15/01048/OUT	27	MTL	Yes	100%	0%	0%
90111	Land At Starvehall Farm New Barn Lane Cheltenham Gloucestershire	Cheltenham	10/01243/OUT	300	NC	Yes	100%	0%	0%

SATURN Zone No	Development name	District	Planning reference (if available)	No. dwellings	Certainty	In Core Scenario?	% Completion (2027)	% Completion (2034)	% Completion (2042)
90112	Christ College Arle Road Cheltenham Gloucestershire GL51 8LE	Cheltenham	14/01317/REM	90	NC	Yes	100%	0%	0%
90113	Travis Perkins Gloucester Road Cheltenham Gloucestershire GL51 0SX	Cheltenham	13/00106/FUL	107	NC	Yes	100%	0%	0%
90114	John Dower House 24 Crescent Place Cheltenham Gloucestershire GL50 3RA	Cheltenham	15/00362/FUL	68	NC	Yes	100%	0%	0%
90115	Premier Products Ltd Bouncers Lane Cheltenham Gloucestershire GL52 5JD	Cheltenham	17/00929/OUT	58	NC	Yes	100%	0%	0%
90116	Phase 1 Land At Old Gloucester Road Cheltenham Gloucestershire	Cheltenham	17/01411/OUT	90	NC	Yes	100%	0%	0%
90118	Land at Perrybrook, Brockworth R	Tewkesbury	12/01256/OUT	1,500	NC	Yes	67%	33%	0%
90120	Innsworth R	Tewkesbury	15/00749/OUT	1,300	NC	Yes	67%	33%	0%
90122	Elms Park R	Tewkesbury	16/02000/OUT	4,285	MTL	Yes	23%	54%	23%
90124	Land To The Rear Of Invista Green Street Brockworth GL3 4LS	Tewkesbury	11/00091/OUT	145	NC	Yes	100%	0%	0%
90125	Nerva Meadows Plots 3200, 7400, 7520 Gloucester Business Park Brockworth	Tewkesbury	15/01378/OUT	106	MTL	Yes	100%	0%	0%
90126	Parcel 3745 Cheltenham Road East Churchdown Gloucester Gloucestershire	Tewkesbury	16/00738/OUT	465	MTL	Yes	87%	13%	0%

SATURN Zone No	Development name	District	Planning reference (if available)	No. dwellings	Certainty	In Core Scenario?	% Completion (2027)	% Completion (2034)	% Completion (2042)
90127	Land At Tewkesbury Road Twigworth	Tewkesbury	15/01149/OUT	995	NC	Yes	50%	43%	7%
90128	Land To East Of Tewkesbury Road And North Of Longford Lane Longford Gloucester Gloucestershire	Tewkesbury	15/00814/APP	269	NC	Yes	100%	0%	0%
90129	Land To East Of Tewkesbury Road And North Of Longford Lane Longford Gloucester Gloucestershire	Tewkesbury	16/00853/FUL	197	MTL	Yes	100%	0%	0%
90130	Cleevelands Evesham Road Bishops Cleeve R	Tewkesbury	10/01216/OUT	550	NC	Yes	100%	0%	0%
90132	Land To The West Of Farm Lane Shurdington	Tewkesbury	14/00838/FUL	377	NC	Yes	100%	0%	0%
90134	Homelands Farm Gotherington Lane Bishops Cleeve GL52 8EN R	Tewkesbury	10/01005/OUT	450	NC	Yes	100%	0%	0%
90136	Land To The West Of Lassington Lane Highnam Gloucester Gloucestershire	Tewkesbury	14/00583/OUT / 16/00858/APP	88	NC	Yes	100%	0%	0%
90137	Part Parcel 3400 Columbine Road Walton Cardiff Tewkesbury Gloucestershire	Tewkesbury	16/00177/FUL	261	NC	Yes	100%	0%	0%
90138	Adjacent 74 Evesham Road Bishops Cleeve Cheltenham Gloucestershire	Tewkesbury	15/01177/FUL	71	NC	Yes	100%	0%	0%
90139	Parcel 7561 Malleson Road Gotherington Cheltenham Gloucestershire	Tewkesbury	16/00965/OUT	50	MTL	Yes	100%	0%	0%

SATURN Zone No	Development name	District	Planning reference (if available)	No. dwellings	Certainty	In Core Scenario?	% Completion (2027)	% Completion (2034)	% Completion (2042)
90140	Part Parcel 0085 Land West Of Bredon Road Bredon Road Tewkesbury Gloucestershire	Tewkesbury	16/00663/APP	68	MTL	Yes	100%	0%	0%
90141	Parcel 3441 And 3629 Land Between Greet Road And Gretton Road Winchcombe	Tewkesbury	13/00986/APP	85	NC	Yes	100%	0%	0%
90142	Land Parcels 4331 4619 And 5837 Pamington Lane Pamington Tewkesbury Gloucestershire	Tewkesbury	14/00972/OUT	150	NC	Yes	100%	0%	0%
90143	Land Adjacent Cornerways High Street Twyning	Tewkesbury	13/00978/FUL	58	NC	Yes	100%	0%	0%
90145	Coopers Edge - Parcels 25A, 25B, 26A, 26B, 27A, 27B	Tewkesbury	15/01274/APP	214	NC	Yes	100%	0%	0%
90146	Land at A38/A4019 Jct	Tewkesbury	17/01337/OUT	50	NC	Yes	100%	0%	0%
90147	Land adj to Hucclecote Road and Golf Club	Tewkesbury	18/01239/FUL	166	NC	Yes	87%	13%	0%
90148	Roman Way, Bourton-on-the-Water	Cotswolds	16/03834/FUL	111	NC	Yes	100%	0%	0%
90149	Land parcel off Station Road, Bourton-on-the-Water	Cotswolds	14/02923/REM	100	NC	Yes	100%	0%	0%
90150	Kingshill Development, London Road, Cirencester R	Cotswolds	15/03117/REM	94	NC	Yes	100%	0%	0%
90152	Land west of Siddington Road and south of North Hill Road, Cirencester	Cotswolds	14/02871/REM	55	NC	Yes	100%	0%	0%
90153	Land west of Pips Field, Cirencester Road, Fairford	Cotswolds	12/02133/FUL	68	NC	Yes	100%	0%	0%

SATURN Zone No	Development name	District	Planning reference (if available)	No. dwellings	Certainty	In Core Scenario?	% Completion (2027)	% Completion (2034)	% Completion (2042)
90154	Land at London Road, Fairford	Cotswolds	15/04461/REM	117	NC	Yes	100%	0%	0%
90155	Land parcel south of Home Farm, Fairford	Cotswolds	15/02707/REM	120	NC	Yes	100%	0%	0%
90156	Land at Top Farm, West Lane, Kemble	Cotswolds	14/03638/REM	50	NC	Yes	100%	0%	0%
90157	Old Station Site, Lechlade	Cotswolds	14/04198/REM	61	NC	Yes	100%	0%	0%
90158	Former Meon Hill Nurseries, Canada Lane, Mickleton	Cotswolds	14/01578/REM	75	NC	Yes	100%	0%	0%
90159	Land parcel off Broad Marston Road, Mickleton	Cotswolds	16/02049/REM	90	NC	Yes	100%	0%	0%
90160	Land adjacent to Arbour Close and Cotswold Edge, Mickleton	Cotswolds	14/03019/REM	70	NC	Yes	100%	0%	0%
90161	Land at Fire Service College, London Road, Moreton-in-Marsh	Cotswolds	11/00940/REM	54	NC	Yes	100%	0%	0%
90162	The Fire Service College, London Road, Moreton-in-Marsh	Cotswolds	16/00858/REM	250	NC	Yes	100%	0%	0%
90163	Land off Todenham Road, Moreton-in-Marsh	Cotswolds	14/04503/REM	105	NC	Yes	100%	0%	0%
90164	Land north of Cirencester Road, GL8 8SA, Tetbury	Cotswolds	17/04978/FUL	128	NC	Yes	100%	0%	0%
90165	Land parcel at Quercus Park, Tetbury	Cotswolds	14/03567/REM	50	NC	Yes	100%	0%	0%
90166	Highfield Farm, Tetbury	Cotswolds	15/02517/REM	133	NC	Yes	100%	0%	0%
90167	Land parcel south of Quercus Road, Quercus Road, Tetbury	Cotswolds	15/03479/REM	123	NC	Yes	100%	0%	0%

SATURN Zone No	Development name	District	Planning reference (if available)	No. dwellings	Certainty	In Core Scenario?	% Completion (2027)	% Completion (2034)	% Completion (2042)
90168	Land parcel at Upper Rissington, Upper Rissington	Cotswolds	12/03810/REM	194	NC	Yes	100%	0%	0%
90169	Land at Chesterton Farm, Cranhams Lane, GL7 6JP, Cirencester R	Cotswolds	16/00054/OUT	2,350	MTL	Yes	58%	42%	0%
90171	Land at Siddington Park Farm, GL7 6ET, Preston	Cotswolds	17/00076/OUT	171	MTL	Yes	67%	33%	0%
90172	Land to the south of Love Lane, Siddington	Cotswolds	15/05165/OUT	88	MTL	Yes	100%	0%	0%
90173	Land adjacent to Bretton House, Station Road, Stow-on-the-Wold	Cotswolds	17/01218/REM	106	NC	Yes	100%	0%	0%
90174	Highfield Farm, Tetbury	Cotswolds	15/02517/REM	117	NC	Yes	100%	0%	0%
90175	Land north of Collin Lane, Willersey	Cotswolds	16/02543/REM	50	NC	Yes	100%	0%	0%
90176	Land at Evenlode Road, Moreton-in-Marsh	Cotswolds	19/00086/OUT	67	NC	Yes	66%	34%	0%
90177	Land south east of Fosseway Avenue, Moreton-in-Marsh	Cotswolds	M_19A - 19/02248/FUL	91	NC	Yes	63%	37%	0%
90179	Former Gloucester Academy Estcourt Close Gloucester GL1 3LR	Gloucester	16/00631/OUT	90	NC	Yes	100%	0%	0%
90180	Hucclecote Centre Churchdown Lane Gloucester GL3 3QN	Gloucester	11/00742/OUT	53	NC	Yes	100%	0%	0%
90181	Former Contract Chemicals Site Bristol Road Gloucester GL2 5BX	Gloucester	07/00474/OUT	86	NC	Yes	100%	0%	0%

SATURN Zone No	Development name	District	Planning reference (if available)	No. dwellings	Certainty	In Core Scenario?	% Completion (2027)	% Completion (2034)	% Completion (2042)
90182	Former Wellman Graham St Gobain Industrial Sites Bristol Road Gloucester GL2 5BX	Gloucester	07/00472/OUT	172	NC	Yes	100%	0%	0%
90183	Land East Of Hempsted Lane Hempsted Lane Gloucester	Gloucester	13/01032/OUT	50	MTL	Yes	100%	0%	0%
90184	Old Hempsted Fuel Depot Hempsted Lane Gloucester	Gloucester	12/00725/OUT	85	NC	Yes	100%	0%	0%
90185	Norville Optical Co Ltd Paul Street Gloucester GL1 4NY	Gloucester	16/00815/FUL	63	NC	Yes	100%	0%	0%
90186	Former Kwik Save 103 Northgate Street Gloucester	Gloucester	16/00142/FUL	95	NC	Yes	100%	0%	0%
90187	Land South Of Grange Road Gloucester	Gloucester	16/00165/OUT	250	NC	Yes	93%	7%	0%
90188	Business School & Student Accommodation	Gloucester	None	80	Complete	Yes	100%	0%	0%
90189	Barbican Carpark, Blackfriars (Phase 1)	Gloucester	None	118	Complete	Yes	100%	0%	0%
90190	Former Gloucester Prison, Barrack Square	Gloucester	None	202	MTL	Yes	100%	0%	0%
90191	Barbican Carpark, Blackfriars (Phase 2)	Gloucester	None	74	MTL	Yes	100%	0%	0%
90192	McCarthy & Stone, Land at Bakers Quay	Gloucester	None	50	NC	Yes	100%	0%	0%
90193	Former Civil Service Club, Estcourt Road	Gloucester	None	100	NC	Yes	100%	0%	0%
90194	Land At Bakers Quay Provender Mill	Gloucester	15/01144/FUL	166	NC	Yes	100%	0%	0%

SATURN Zone No	Development name	District	Planning reference (if available)	No. dwellings	Certainty	In Core Scenario?	% Completion (2027)	% Completion (2034)	% Completion (2042)
90195	Mayos Land Bristol Road Quedgeley Gloucester	Gloucester	13/01013/REM	49	Complete	Yes	100%	0%	0%
90196	Former Gloscat Buildings Brunswick Road Gloucester	Gloucester	11/00107/FUL	190	Complete	Yes	100%	0%	0%
90197	Flats - Land At Bakers Quay Monk Meadow	Gloucester	14/00709/FUL	409	NC	Yes	100%	0%	0%
90198	Kingsway Framework All Areas	Gloucester	None	692	NC	Yes	100%	0%	0%
90199	Larger Winnycroft Development Site (close to B4073 Painswick Rd, west of M5)	Gloucester	14/01063/OUT	420	NC	Yes	100%	0%	0%
90200	Little Winnycroft Development Site (close to B4073 Painswick Rd, west of M5)	Gloucester	14/01063/OUT	217	NC	Yes	100%	0%	0%
90203	Sellars Farm Sellars Road Hardwicke Glos.	Stroud	S.12/2528/REM	64	Complete	Yes	100%	0%	0%
90204	Land at Box Road Cam Durlsey Glos.	Stroud	S.11/1682/FUL	54	Complete	Yes	100%	0%	0%
90205	Parcel 16B And 19B Land To The West And South Of Gloucester Business Park Upton St Leonards	Stroud	S.16/1558/REM	79	Complete	Yes	100%	0%	0%
90206	Land South Of Leonard Stanley Primary School Bath Road Leonard Stanely Glos.	Stroud	S.16/1398/REM	75	Complete	Yes	100%	0%	0%
90207	Land At Colethrop Farm Bath Road Hardwicke	Stroud	S.17/2215/REM	53	Complete	Yes	100%	0%	0%
90208	Land West of Stonehouse Nastend Lane	Stroud	S.14/0810/OUT	1,332	NC	Yes	85%	15%	0%

SATURN Zone No	Development name	District	Planning reference (if available)	No. dwellings	Certainty	In Core Scenario?	% Completion (2027)	% Completion (2034)	% Completion (2042)
90209	Colethrop Farm (Hunt's Grove)	Stroud	S.09/1692/VAR	1,273	NC	Yes	90%	10%	0%
90210	SA3 Land north east of Draycott Cam	Stroud	S.15/2804/OUT	450	NC	Yes	68%	32%	0%
90211	Land at Littlecombe	Stroud	S.15/0476/OUT	124	NC	Yes	100%	0%	0%
90212	Land at rear of Canonbury Street Berkeley	Stroud	S.14/0619/FUL	170	NC	Yes	100%	0%	0%
90213	Former Standish Hospital and former Westridge Hospital Standish	Stroud	S.17/2729/FUL	147	NC	Yes	100%	0%	0%
90214	Dudbridge Industrial Estate Dudbridge Road Stroud	Stroud	S.17/1987/OUT	130	NC	Yes	100%	0%	0%
90215	Wimberley Mill Knapp Lane Brimscombe	Stroud	S.13/2668/OUT	104	NC	Yes	100%	0%	0%
90216	Land north west of Box Road Cam	Stroud	S.17/1366/OUT	90	NC	Yes	100%	0%	0%
90217	Rooksmoor Mills Bath Road Woodchester	Stroud	S.13/1893/FUL	54	NC	Yes	100%	0%	0%
90218	Daniels Industrial Estate 104 Bath Road Stroud	Stroud	S.16/2152/OUT	50	NC	Yes	100%	0%	0%
94001	South Churchdown	Tewkesbury	N/A	635	H	No	0%	0%	100%
94002	West Cheltenham Safeguarded Land R	Cheltenham	N/A	0	H	No	0%	0%	100%
94003	Northwest Cheltenham Safeguarded Land R	Cheltenham	N/A	2,258	H	Yes	0%	19%	81%
96001-12	Tewkesbury Garden Town	Tewkesbury	N/A	9,195	H	No	0%	0%	100%
90220	Fiddington	Tewkesbury	N/A	850	H	Yes	0%	100%	0%

SATURN Zone No	Development name	District	Planning reference (if available)	No. dwellings	Certainty	In Core Scenario?	% Completion (2027)	% Completion (2034)	% Completion (2042)
94004	Sharpness Docks	Stroud	N/A	300	H	No	0%	0%	100%
94005	Sharpness	Stroud	N/A	2,400	H	No	0%	0%	100%
94006	Wisloe	Stroud	N/A	1,500	H	No	0%	0%	100%
94007	South of Hardwicke	Stroud	N/A	1,200	H	No	0%	0%	100%
94008	Hunts Grove Ext	Stroud	N/A	750	H	No	0%	0%	100%
94009	Cam North West	Stroud	N/A	700	H	No	0%	0%	100%
94010	Cam North East	Stroud	N/A	180	H	No	0%	0%	100%
94011	Stonehouse North West	Stroud	N/A	650	H	No	0%	0%	100%
94012	Local Sites	Stroud	N/A	1,045	H	No	0%	0%	100%
94013	Whaddon	Gloucester	N/A	2,500	H	No	0%	0%	100%
90219	StokeRoad_R	Tewkesbury	18/00249/OUT	215	MTL	Yes	100%	0%	0%

Certainty: NC- Near Certain, MTL- More than likely, RF- Reasonably Foreseeable, H- Hypothetical

Table A2 : Forecast employment and retail sites

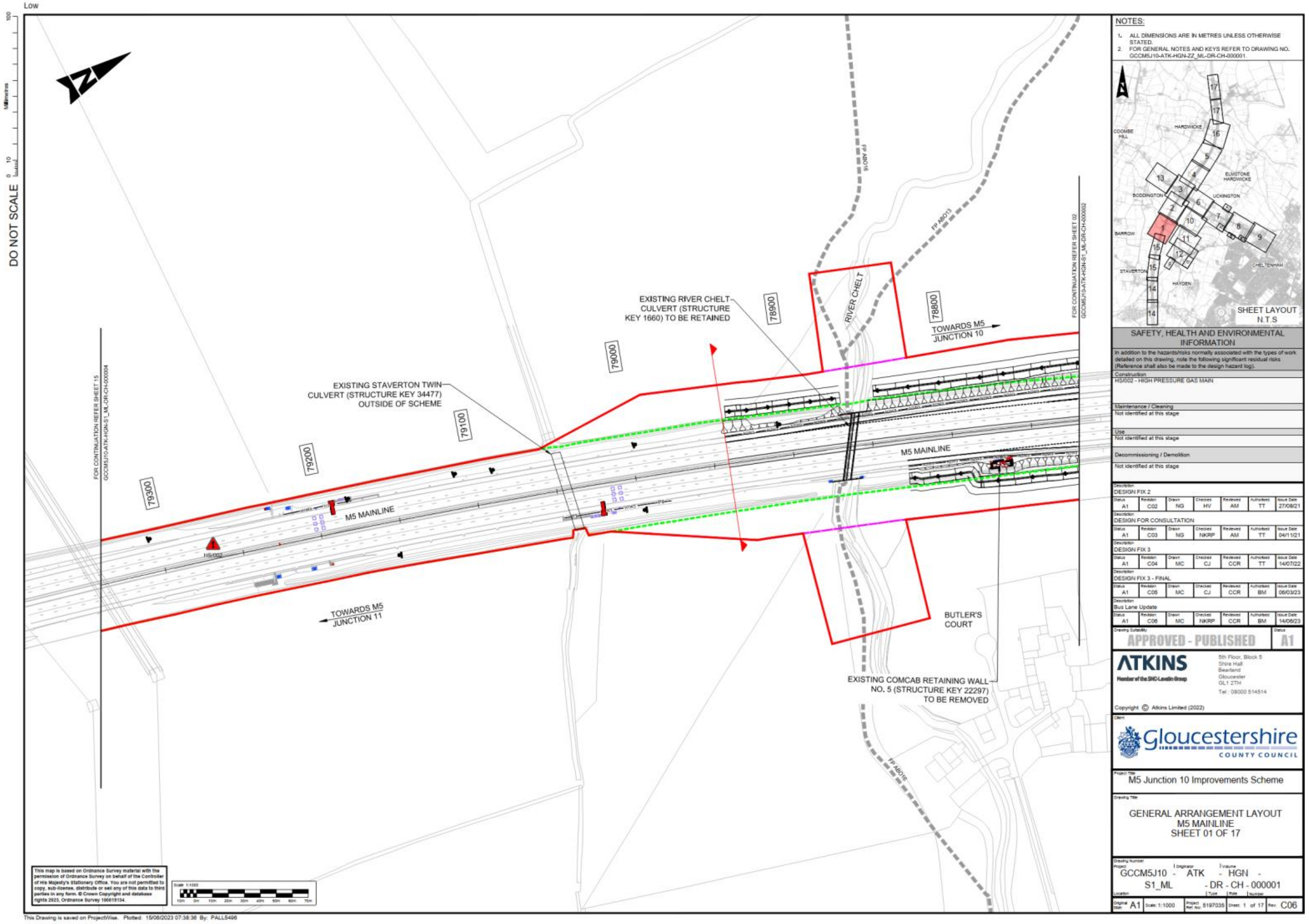
Zone	Development name	District	Planning reference (if available)	Land Use	Site Area (m2)	Size (sqm GFA)	Certainty	In Core Scenario?	Jobs post March	B1 (%)	B2 (%)	B8 (%)	% Completed (2027)	% Completed (2034)	% Completed (2042)
91102	West Cheltenham Employment (Cheltenham Cyber Park Employment)	Cheltenham	None	50% B1 (a); 24% B2 (c); 24% B2 (d)	515,900	210,287	MTL	Yes	8,178	50%	50%	0%	33%	52%	15%
91109	Land To Rear Of Nuffield Hospital Hatherley Lane Cheltenham Gloucestershire E	Cheltenham	15/01048/OUT	100% B1 (a)	8,787	3,680	MTL	Yes	201	100%	0%	0%	100%	0%	0%
91110	Land At North Road West And Grovefield Way Cheltenham Gloucestershire	Cheltenham	18/01004/FUL	73% B1 (a); 11% B2 (c); 11% B2 (d); 2% B8 (e); 2% B8 (f); 2% B8 (g)	41,300	8,158	MTL	Yes	544	73%	21%	6%	100%	0%	0%
91117	JCS Strategic Allocation Site A9 - Ashchurch	Tewkesbury	13/01003/OUT	100% retail	143,000	25,545	NC	Yes	581	0%	0%	0%	100%	0%	0%
91119	Land at Perrybrook, Brockworth Employment	Tewkesbury	12/01256/OUT	50% B1 (a); 17% B8 (e); 17% B8 (f); 17% B8 (g)	33,000	22,000	NC	Yes	540	50%	0%	50%	67%	33%	0%
91121	Innsworth Employment	Tewkesbury	15/00749/OUT	80% B1 (a); 10% B2 (c); 10% B2 (d)	40,800	16,320	NC	Yes	750	80%	20%	0%	67%	33%	0%
91123	Elms Park Employment	Tewkesbury	16/02000/OUT	100% B1 (a)	100,000	36,000	MTL	Yes	1,852	50%	22%	28%	43%	49%	7%
91131	Cleevelands Evesham Road Bishops Cleeve Employment	Tewkesbury	10/01216/OUT	100% B1 (a)	-	3,750	NC	Yes	250	100%	0%	0%	100%	0%	0%
91133	Plot 6200 Gloucester Business Park Brockworth Gloucester Gloucestershire	Tewkesbury	17/00005/APP	100% B2 (c)	35,500	9,738	MTL	Yes	293	0%	100%	0%	67%	33%	0%
91135	Homelands Farm Gotherington Lane Bishops Cleeve GL52 8EN Employment	Tewkesbury	10/01005/OUT	100% B1 (a)	-	500	NC	Yes	50	100%	0%	0%	100%	0%	0%
91144	Land On The East Side Of Cheltenham Road East Churchdown Gloucester	Tewkesbury	15/01115/FUL	20% B1 (a); 40% B2 (c); 40% B2 (d)	45,527	18,933	NC	Yes	300	20%	80%	0%	67%	33%	0%
91151	Kingshill Development, London Road, Cirencester Employment	Cotswolds	15/03117/REM	100% B1 (a)	-	5,000	NC	Yes	503	100%	0%	0%	100%	0%	0%
91170	Land at Chesterton Farm, Cranhams Lane, GL7 6JP, Cirencester Employment	Cotswolds	16/00054/OUT	70% B1 (a); 7% B2 (c); 7% B2 (d); 5% B8 (e); 5% B8 (f); 5% B8 (g)	-	43,664	MTL	Yes	500	70%	15%	15%	58%	42%	0%
91178	Land At Barnwood Link Road Gloucester	Gloucester	14/01035/OUT	33% B1 (a); 17% B2 (c); 17% B2 (d); 11% B8 (e); 11% B8 (f); 11% B8 (g)	570,000	28,673	NC	Yes	1,156	33%	32%	0%	100%	0%	0%
91201	Gateway 12 Davy Way, Hardwicke, Gloucester, Gloucestershire	Stroud	S.14/1518/FUL	33% B1 (a); 17% B2 (c); 17% B2 (d); 11% B8 (e); 11% B8 (f); 11% B8 (g)	21,900	7,562	NC	Yes	467	33%	33%	33%	100%	0%	0%
91202	Land at Quedgeley Trading Estate East Haresfield Stonehouse	Stroud	16/1724/OUT	100% B1 (a)	148,000	66,011	MTL	Yes	2,149	100%	0%	0%	100%	0%	0%
95001	South Churchdown	Tewkesbury	N/A	50% B1; 22% B2; 28% B8	174,000	62,640	H	No	3,223	0%	0%	0%	0%	0%	100%
95002	West Cheltenham Safeguarded Land	Cheltenham	N/A	50% B1; 22% B2; 28% B8	0	0	H	No	0	0%	0%	0%	0%	0%	100%
95003	Northwest Cheltenham Safeguarded Land	Cheltenham	N/A	50% B1; 22% B2; 28% B8	300,000	108,000	H	Yes	5,556	50%	22%	28%	0%	27%	73%
95004	Fiddington Employment	Tewkesbury	N/A	38% B1; 63% B8	1,200,000	480,000	H	No	18,896	38%	0%	63%	0%	0%	100%
91203	Stoke Road Employment	Tewkesbury	18/00249/OUT	61% B1; 39% B8	22,000	6,880	NC	No	468	61%	0%	39%	100%	0%	0%
91204	StokeRoad_T	Tewkesbury	18/00249/OUT		2000	280			16				100%	0%	0%

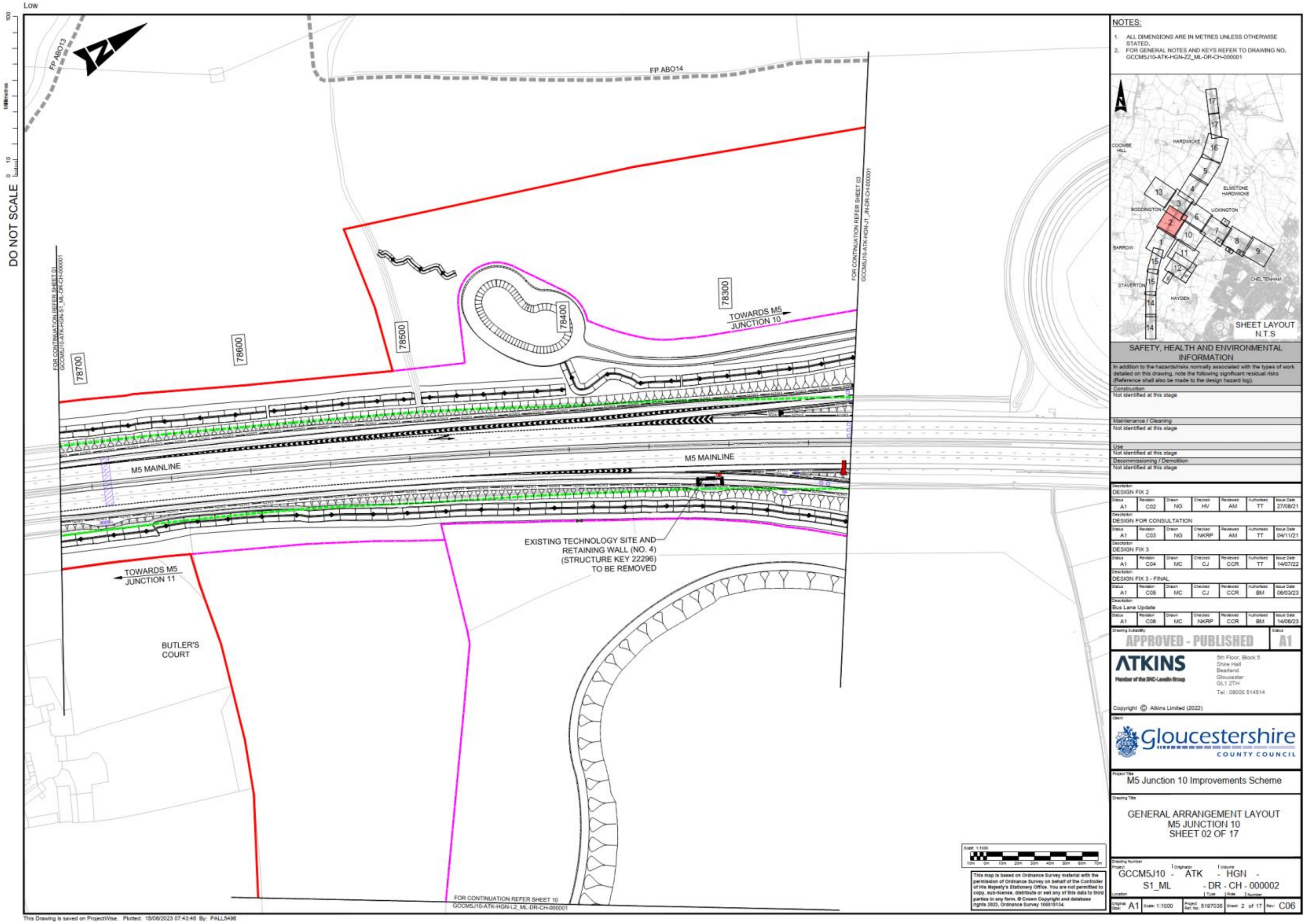
Appendix B. Highway Scheme Uncertainty Log

Ref	Scheme name	X	Y	Scheme status	Area of network included in
1	Fiddington developments (residential, employment, retail)	392254	232787	Near certain	Simulation
2	A417 Missing Link	393654	214654	More than likely	Simulation
3	West of Cheltenham (WoC) A40 Phase 1 - Arle Court	391177	221791	Near certain	Simulation
4	WoC A40 Phase 2 - M5 J11	390149	221407	Near certain	Simulation
5	WoC A40 Phase 3 - Arle Court to Benhall	391938	222096	Near certain	Simulation
6	WoC A40 Phase 4 - Benhall to Griffiths Ave	392281	221990	Near certain	Simulation
7	Elmbridge Transport Scheme and A40 Elmbridge Court, Gloucester	386625	220161	Complete (2017)	Simulation
8	A417/A40 Barnwood Link	386564	218866	Under construction	Simulation
9	A435/Hyde Lane/Southam Lane Signalised Junction improvements	395519	225879	Near certain	Simulation
10	A419 corridor improvements, Stonehouse	379469	205352	Near certain	Simulation
11	A419 White Hart junction improvement, Swindon	418564	186421	Near certain	Simulation
12	A38 Cross Key roundabout	380124	211929	Near certain	Simulation
13	A40 Longford roundabout junction improvement, Gloucester	383688	220474	Near certain	Simulation
14	A40 access roundabout addition, Innsworth	384948	220656	Near certain	Simulation
15	Innsworth Development Roundabout Improvement	385927	221138	Near certain	Simulation
16	A430 Llanthony Rd and St Ann Way (Southwest bypass) improvement, Gloucester	382230	217905	Near certain	Simulation
17	A40 Over Roundabout improvement (phase 2), Gloucester	381866	219659	Near certain/ partially complete	Simulation
18	A38 Tewkesbury Road (Twigworth)	384597	222083	Near certain	Simulation

Ref	Scheme name	X	Y	Scheme status	Area of network included in
19	Perrybrook (Brockworth) development	388324	217213	Under construction	Simulation
20	M4 J15-17	410225	182940	Certain	Simulation
21	A38, M5 J16 to Aztec West, Almondsbury	360771	182864	Certain	Simulation
22	M49 Avonmouth Junction	353682	178628	More than likely	Simulation
23	M5 J25	325493	124801	Certain	Buffer
24	Staplegrove, Taunton	321500	126045	Certain	Buffer
25	Northern Inner Distribution Road (NIDR), Taunton	322396	125475	Complete (2018)	Buffer
26	A358 Taunton to Southfields	329280	120440	More than likely	Buffer
27	A303 Sparkford - Ilchester dualling	355811	124942	More than likely	Buffer
28	A303 Amesbury to Berwick Down	412289	141980	More than likely	Buffer
29	A34 Milton Interchange Improvement	448357	191311	Certain	Buffer
30	A34 Chilton Interchange Improvement	448768	186135	Certain	Buffer
31	A380 South Devon Highway (Kingskerswell Bypass)	287387	677551	Certain	Buffer
32	Fiddington Development Mitigation measures	391727	233114	More than likely	Simulation

Appendix C. J10 Scheme Drawings

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FP ABO13
FP ABO14
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
78700
78600
78500
78400
78300
TOWARDS M5 JUNCTION 10
TOWARDS M5 JUNCTION 11
M5 MAINLINE
M5 MAINLINE
EXISTING TECHNOLOGY SITE AND RETAINING WALL (NO. 4) (STRUCTURE KEY 22296) TO BE REMOVED
BUTLER'S COURT
FOR CONTINUATION REFER SHEET 10
APPROVED - PUBLISHED
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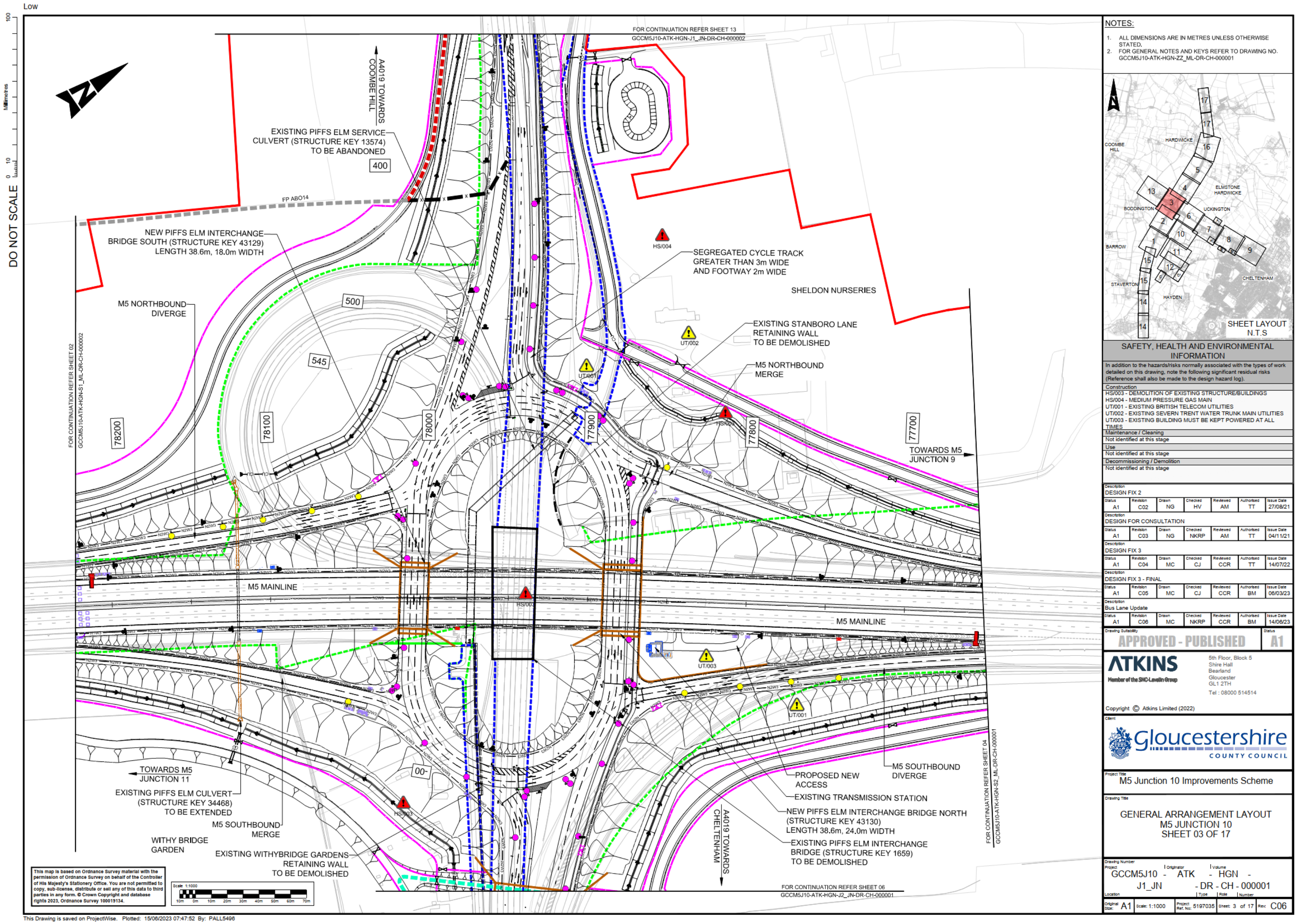
M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
M5 JUNCTION 10
SHEET 02 OF 17
GCCM5J10 - ATK - HGN - S1_ML - DR - CH - 000002
A1
C06


DO NOT SCALE
EXISTING PIFFS ELM SERVICE CULVERT (STRUCTURE KEY 13574) TO BE ABANDONED
A4019 TOWARDS COOMBE HILL
NEW PIFFS ELM INTERCHANGE BRIDGE SOUTH (STRUCTURE KEY 43129) LENGTH 38.6m, 18.0m WIDTH
M5 NORTHBOUND DIVERGE
SEGREGATED CYCLE TRACK GREATER THAN 3m WIDE AND FOOTWAY 2m WIDE
SHELDON NURSERIES
EXISTING STANBORO LANE RETAINING WALL TO BE DEMOLISHED
M5 NORTHBOUND MERGE
TOWARDS M5 JUNCTION 9
M5 MAINLINE
M5 MAINLINE
TOWARDS M5 JUNCTION 11
EXISTING PIFFS ELM CULVERT (STRUCTURE KEY 34468) TO BE EXTENDED
M5 SOUTHBOUND MERGE
WITHY BRIDGE GARDEN
EXISTING WITHYBRIDGE GARDENS RETAINING WALL TO BE DEMOLISHED
A4019 TOWARDS CHELTENHAM
PROPOSED NEW ACCESS
M5 SOUTHBOUND DIVERGE
EXISTING TRANSMISSION STATION
NEW PIFFS ELM INTERCHANGE BRIDGE NORTH (STRUCTURE KEY 43130) LENGTH 38.6m, 24.0m WIDTH
EXISTING PIFFS ELM INTERCHANGE BRIDGE (STRUCTURE KEY 1659) TO BE DEMOLISHED
78200
78100
78000
77900
77800
77700
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
APPROVED - PUBLISHED
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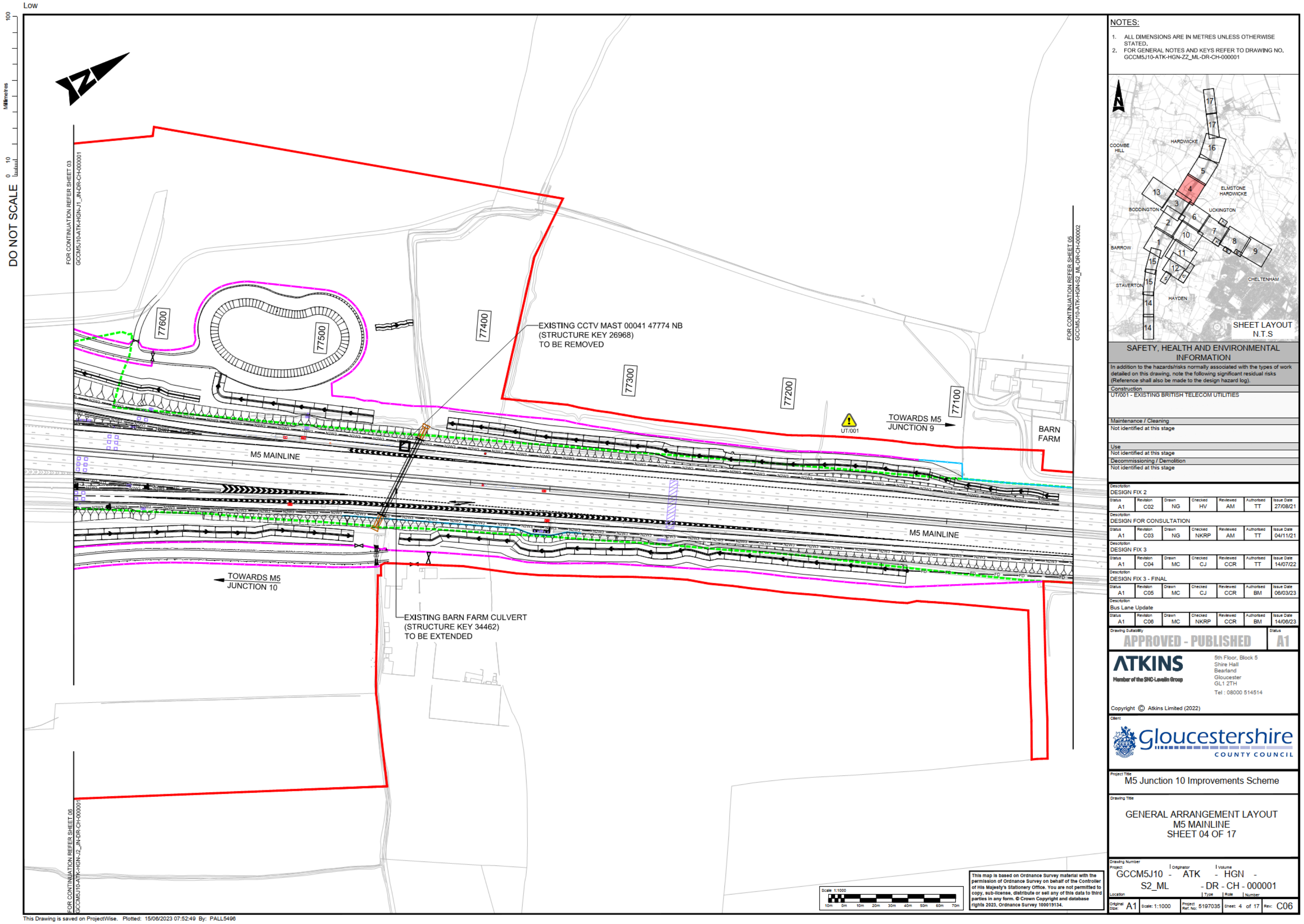
M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT M5 JUNCTION 10 SHEET 03 OF 17
GCCM5J10 - ATK - HGN - J1_JN - DR - CH - 000001
A1
C06


DO NOT SCALE
M5 MAINLINE
M5 MAINLINE
EXISTING CCTV MAST 00041 47774 NB
(STRUCTURE KEY 26968)
TO BE REMOVED
TOWARDS M5
JUNCTION 9
TOWARDS M5
JUNCTION 10
BARN
FARM
EXISTING BARN FARM CULVERT
(STRUCTURE KEY 34462)
TO BE EXTENDED
77600
77500
77400
77300
77200
77100
UT/001
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001
SHEET LAYOUT
N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
UT/001 - EXISTING BRITISH TELECOM UTILITIES
Not identified at this stage
DESIGN FIX 2
DESIGN FOR CONSULTATION
DESIGN FIX 3
DESIGN FIX 3 - FINAL
Bus Lane Update
APPROVED - PUBLISHED
A1
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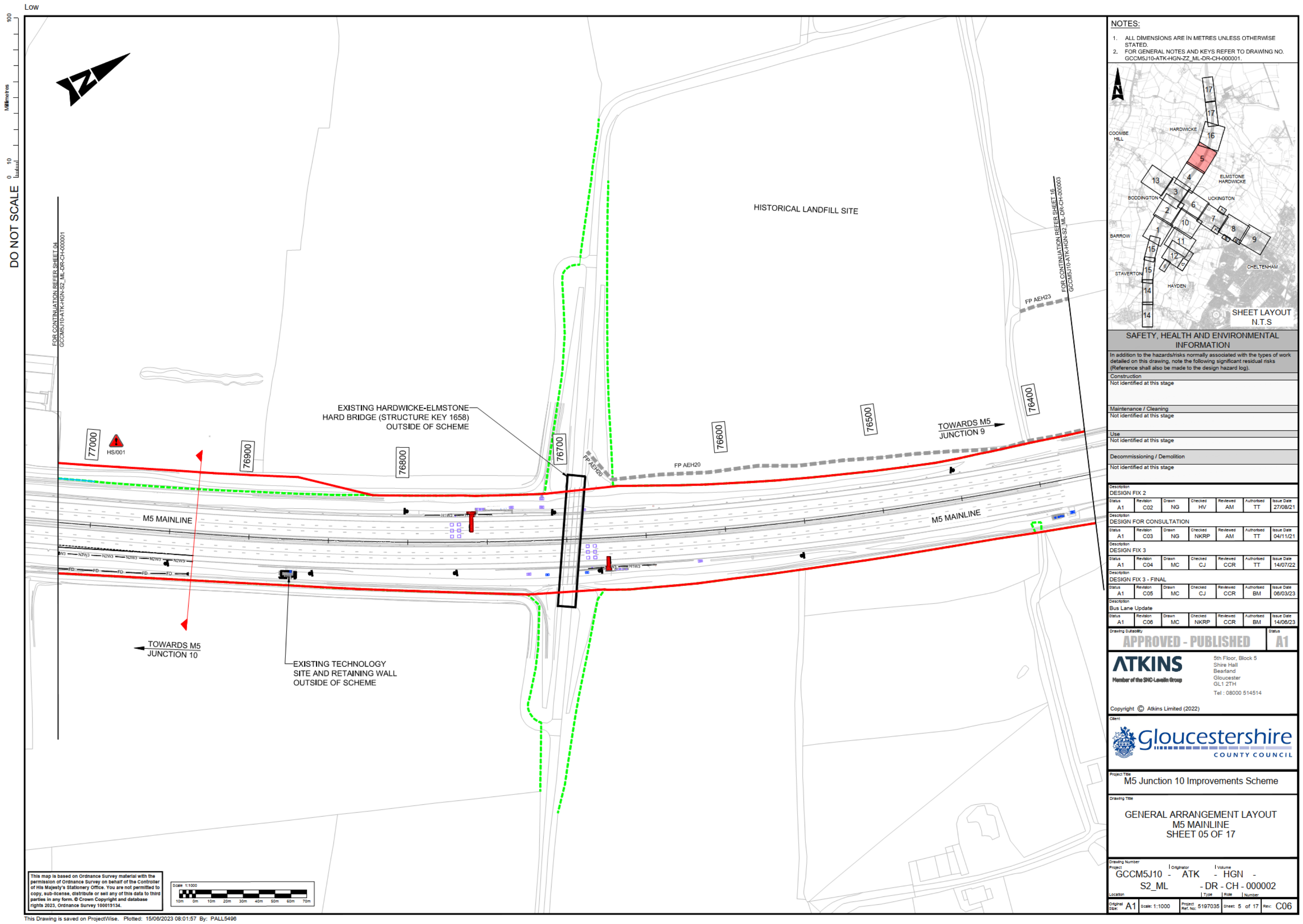
M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
M5 MAINLINE
SHEET 04 OF 17
GCCM5J10 - ATK - HGN -
S2_ML - DR - CH - 000001
C06


DO NOT SCALE
EXISTING HARDWICKE-ELMSTONE HARD BRIDGE (STRUCTURE KEY 1658) OUTSIDE OF SCHEME
HISTORICAL LANDFILL SITE
M5 MAINLINE
TOWARDS M5 JUNCTION 9
TOWARDS M5 JUNCTION 10
EXISTING TECHNOLOGY SITE AND RETAINING WALL OUTSIDE OF SCHEME
FP AEH20
FP AEH23
77000
76900
76800
76700
76600
76500
76400
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001.
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
Construction
Not identified at this stage
Maintenance / Cleaning
Not identified at this stage
Use
Not identified at this stage
Decommissioning / Demolition
Not identified at this stage
DESIGN FIX 2
A1 C02 NG HV AM TT 27/08/21
DESIGN FOR CONSULTATION
A1 C03 NG NKRP AM TT 04/11/21
DESIGN FIX 3
A1 C04 MC CJ CCR TT 14/07/22
DESIGN FIX 3 - FINAL
A1 C05 MC CJ CCR BM 06/03/23
Bus Lane Update
A1 C06 MC NKRP CCR BM 14/06/23
APPROVED - PUBLISHED
A1
ATKINS
5th Floor, Block 5
Shire Hall
Bearland
Gloucester
GL1 2TH
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M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
M5 MAINLINE
SHEET 05 OF 17
GCCM5J10 - ATK - HGN - S2_ML - DR - CH - 000002
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Sheet: 5 of 17
Rev: C06
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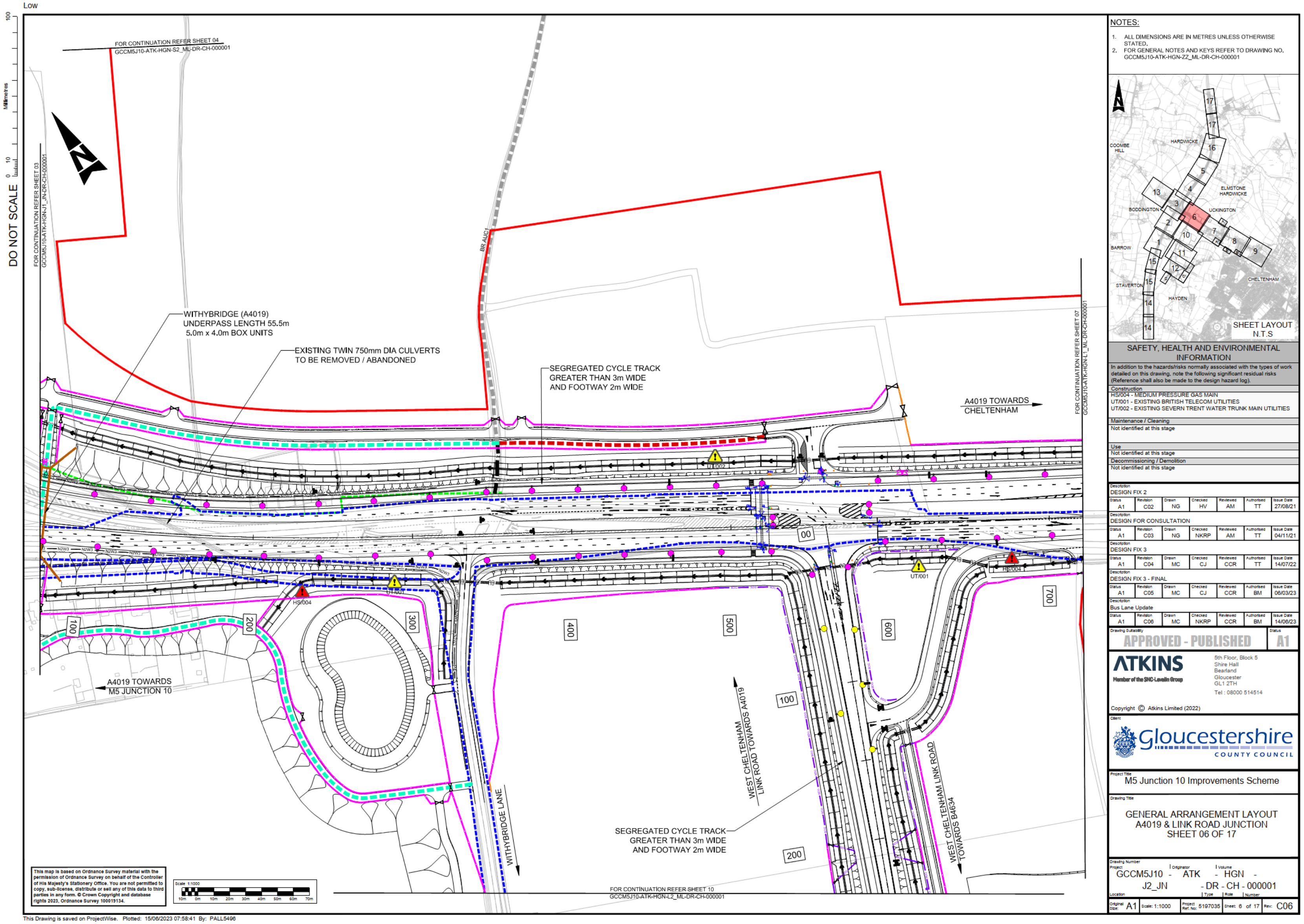
FOR CONTINUATION REFER SHEET 04
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DO NOT SCALE
WITHYBRIDGE (A4019) UNDERPASS LENGTH 55.5m 5.0m x 4.0m BOX UNITS
EXISTING TWIN 750mm DIA CULVERTS TO BE REMOVED / ABANDONED
SEGREGATED CYCLE TRACK GREATER THAN 3m WIDE AND FOOTWAY 2m WIDE
A4019 TOWARDS CHELTENHAM
A4019 TOWARDS M5 JUNCTION 10
WITHYBRIDGE LANE
WEST CHELTENHAM LINK ROAD TOWARDS A4019
WEST CHELTENHAM LINK ROAD TOWARDS B4634
FOR CONTINUATION REFER SHEET 10
GCCM5J10-ATK-HGN-L2_ML-DR-CH-000001
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
HS/004 - MEDIUM PRESSURE GAS MAIN
UT/001 - EXISTING BRITISH TELECOM UTILITIES
UT/002 - EXISTING SEVERN TRENT WATER TRUNK MAIN UTILITIES
APPROVED - PUBLISHED
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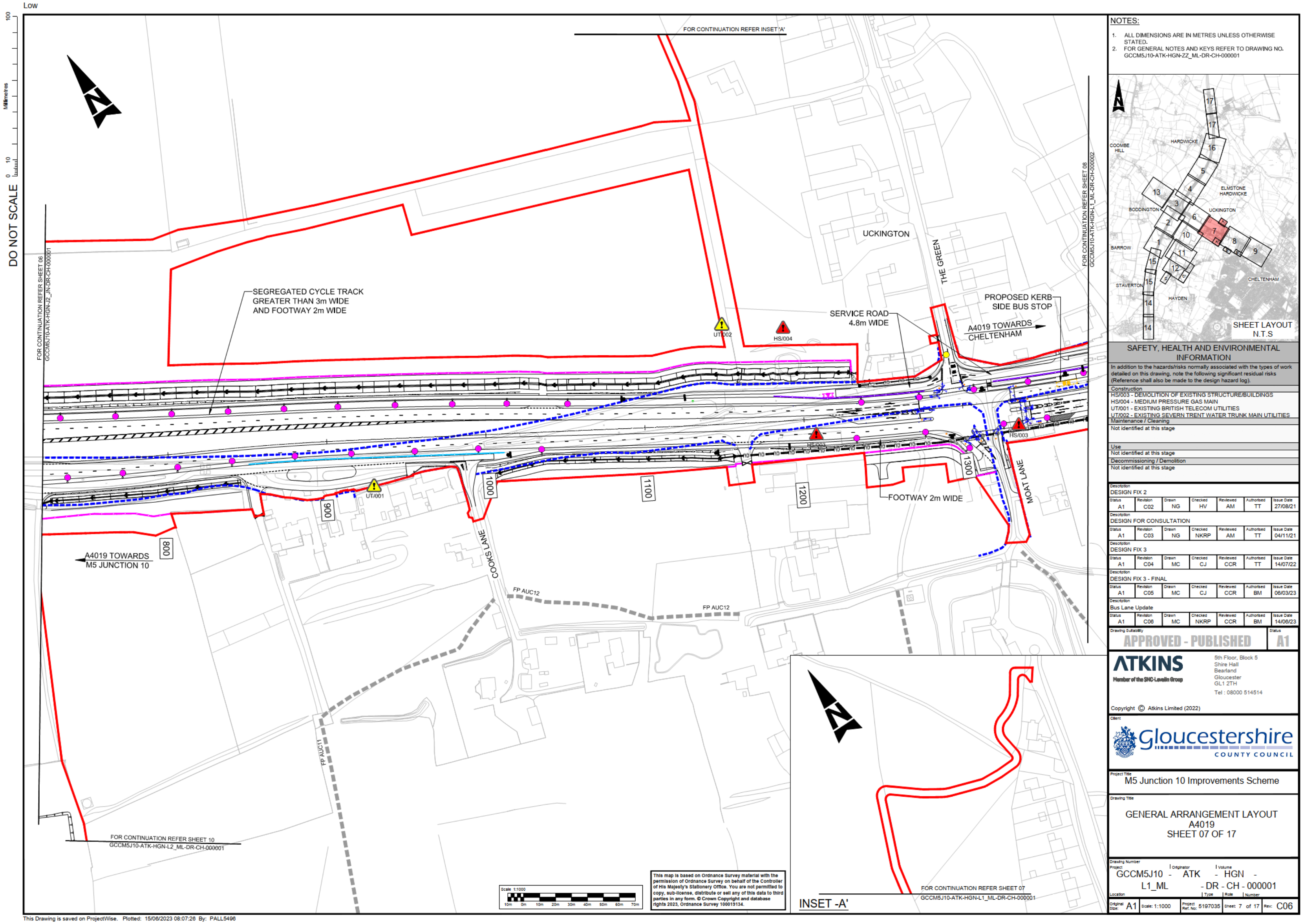
M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT A4019 & LINK ROAD JUNCTION SHEET 06 OF 17
GCCM5J10 - ATK - HGN - J2_JN - DR - CH - 000001
A1 Scale 1:1000 C06


DO NOT SCALE
FOR CONTINUATION REFER INSET 'A'
UCKINGTON
THE GREEN
SEGREGATED CYCLE TRACK GREATER THAN 3m WIDE AND FOOTWAY 2m WIDE
SERVICE ROAD 4.8m WIDE
PROPOSED KERB SIDE BUS STOP
A4019 TOWARDS CHELTENHAM
A4019 TOWARDS M5 JUNCTION 10
COOKS LANE
MOAT LANE
FOOTWAY 2m WIDE
FP AUC12
FP AUC11
INSET -A'
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
HS/003 - DEMOLITION OF EXISTING STRUCTURE/BUILDINGS
HS/004 - MEDIUM PRESSURE GAS MAIN
UT/001 - EXISTING BRITISH TELECOM UTILITIES
UT/002 - EXISTING SEVERN TRENT WATER TRUNK MAIN UTILITIES
APPROVED - PUBLISHED
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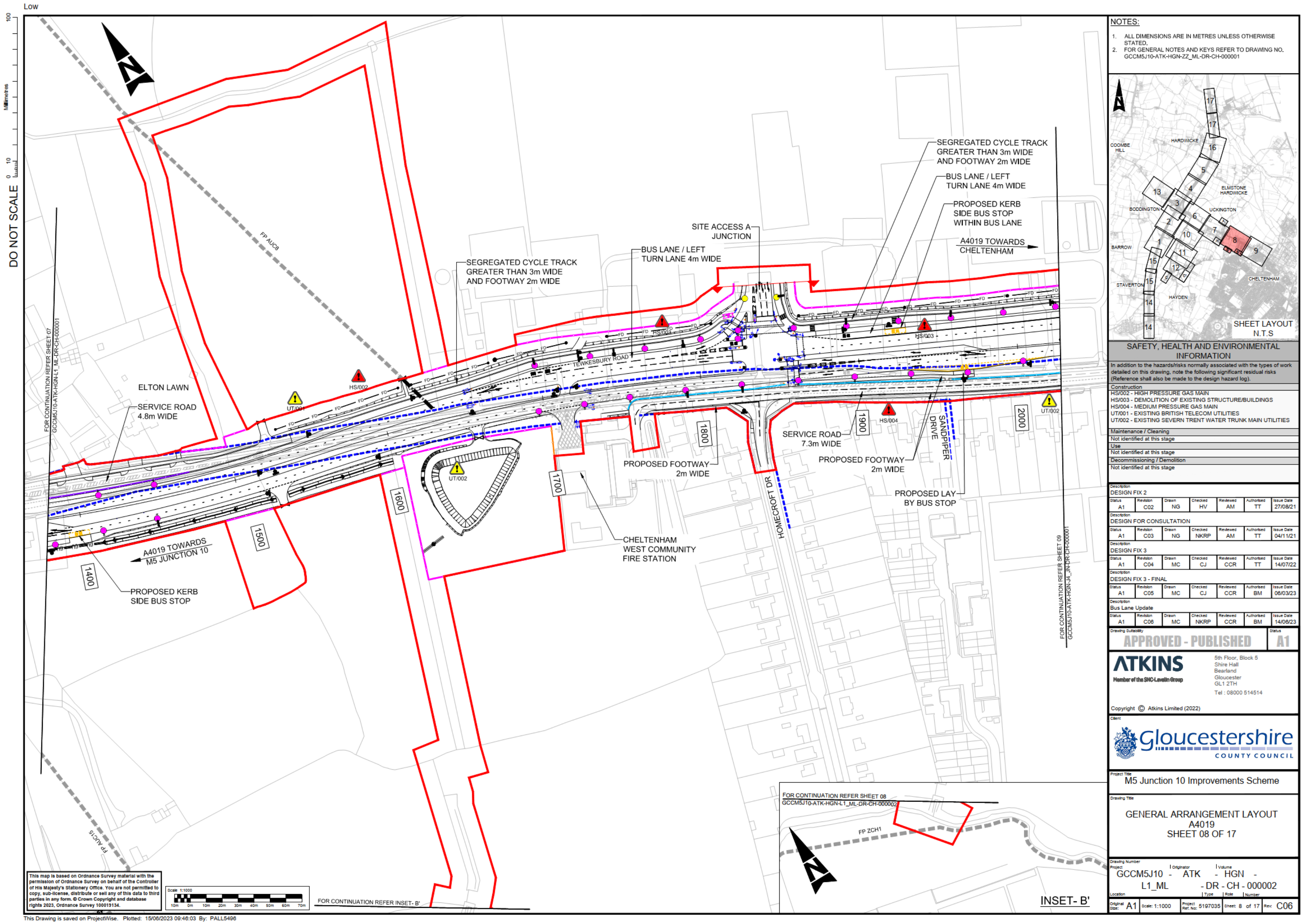
M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
A4019
SHEET 07 OF 17
GCCM5J10 - ATK - HGN - L1_ML - DR - CH - 000001
C06


DO NOT SCALE
SEGREGATED CYCLE TRACK GREATER THAN 3m WIDE AND FOOTWAY 2m WIDE
BUS LANE / LEFT TURN LANE 4m WIDE
PROPOSED KERB SIDE BUS STOP WITHIN BUS LANE
A4019 TOWARDS CHELTENHAM
SITE ACCESS A JUNCTION
ELTON LAWN
SERVICE ROAD 4.8m WIDE
TEWKESBURY ROAD
A4019 TOWARDS M5 JUNCTION 10
PROPOSED KERB SIDE BUS STOP
CHELTENHAM WEST COMMUNITY FIRE STATION
PROPOSED FOOTWAY 2m WIDE
SERVICE ROAD 7.3m WIDE
HOMECROFT DR
SANDPIPER DRIVE
PROPOSED LAY BY BUS STOP
1400
1500
1600
1700
1800
1900
2000
HS/002
HS/003
HS/004
UT/001
UT/002
FP AUC5
FP ZCH1
INSET- B'
FOR CONTINUATION REFER SHEET 08
FOR CONTINUATION REFER INSET- B'
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001
SHEET LAYOUT N.T.S
COOMBE HILL
HARDWICKE
ELMSTONE HARDWICKE
BODDINGTON
UCKINGTON
BARROW
STAVERTON
HAYDEN
CHELTENHAM
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
HS/002 - HIGH PRESSURE GAS MAIN
HS/003 - DEMOLITION OF EXISTING STRUCTURE/BUILDINGS
HS/004 - MEDIUM PRESSURE GAS MAIN
UT/001 - EXISTING BRITISH TELECOM UTILITIES
UT/002 - EXISTING SEVERN TRENT WATER TRUNK MAIN UTILITIES
Maintenance / Cleaning
Not identified at this stage
Use
Not identified at this stage
Decommissioning / Demolition
Not identified at this stage
DESIGN FIX 2 | A1 | C02 | NG | HV | AM | TT | 27/08/21
DESIGN FOR CONSULTATION | A1 | C03 | NG | NKRP | AM | TT | 04/11/21
DESIGN FIX 3 | A1 | C04 | MC | CJ | CCR | TT | 14/07/22
DESIGN FIX 3 - FINAL | A1 | C05 | MC | CJ | CCR | BM | 06/03/23
Bus Lane Update | A1 | C06 | MC | NKRP | CCR | BM | 14/06/23
APPROVED - PUBLISHED
A1
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Bearland
Gloucester
GL1 2TH
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M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
A4019
SHEET 08 OF 17
GCCM5J10 - ATK - HGN - L1_ML - DR - CH - 000002
Original Size: A1
Scale: 1:1000
Project Ref. No: 5197035
Sheet: 8 of 17
Rev: C06
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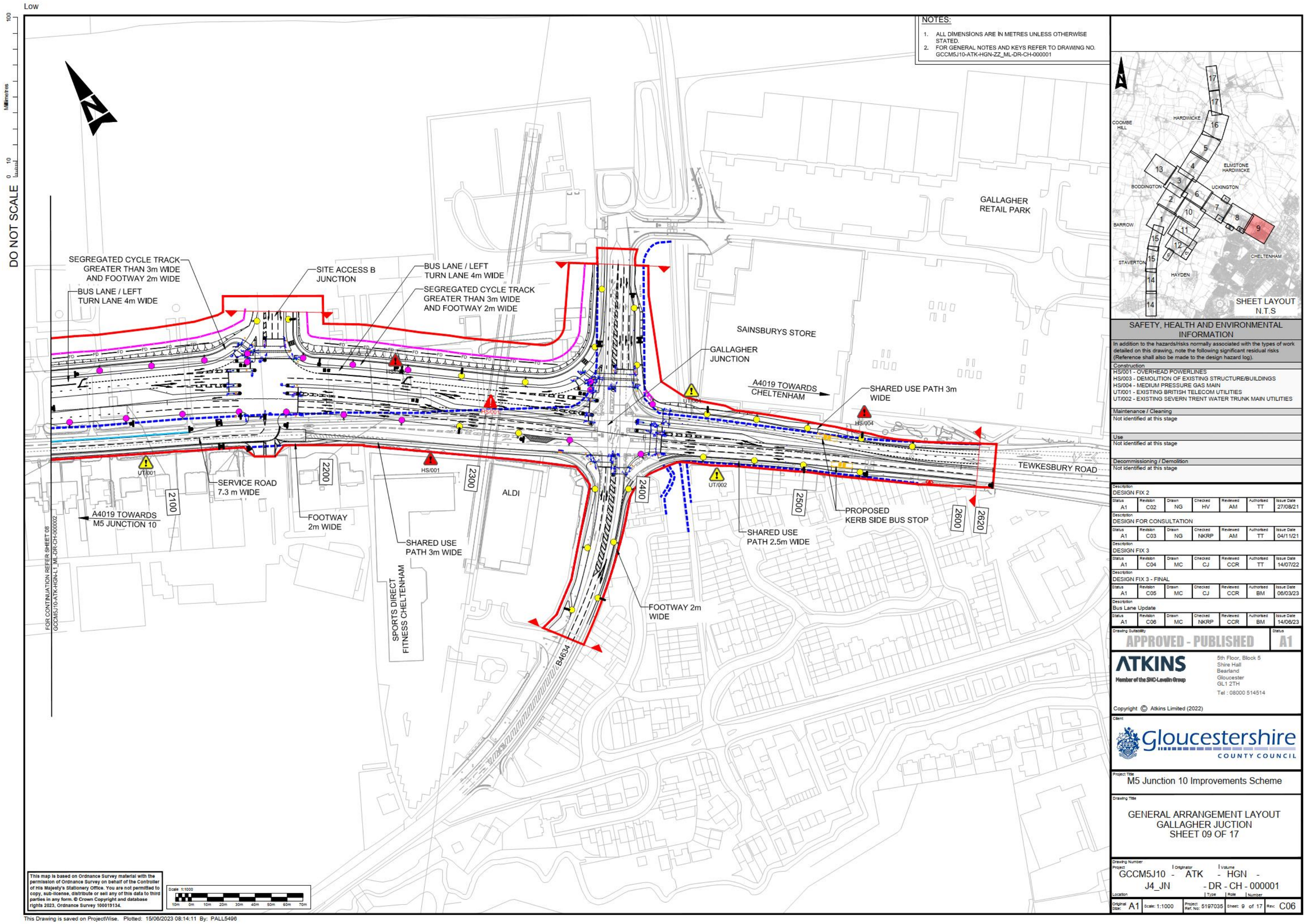
DO NOT SCALE
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001
SEGREGATED CYCLE TRACK GREATER THAN 3m WIDE AND FOOTWAY 2m WIDE
BUS LANE / LEFT TURN LANE 4m WIDE
SITE ACCESS B JUNCTION
BUS LANE / LEFT TURN LANE 4m WIDE
SEGREGATED CYCLE TRACK GREATER THAN 3m WIDE AND FOOTWAY 2m WIDE
GALLAGHER RETAIL PARK
SAINSBURYS STORE
GALLAGHER JUNCTION
A4019 TOWARDS CHELTENHAM
SHARED USE PATH 3m WIDE
TEWKESBURY ROAD
SERVICE ROAD 7.3 m WIDE
A4019 TOWARDS M5 JUNCTION 10
FOOTWAY 2m WIDE
SHARED USE PATH 3m WIDE
ALDI
SPORTS DIRECT FITNESS CHELTENHAM
FOOTWAY 2m WIDE
SHARED USE PATH 2.5m WIDE
PROPOSED KERB SIDE BUS STOP
B4634
2100
2200
2300
2400
2500
2600
2620
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
Construction
HS/001 - EXISTING OVERHEAD POWERLINES
HS/003 - DEMOLITION OF EXISTING STRUCTURE/BUILDINGS
HS/004 - MEDIUM PRESSURE GAS MAIN
UT/001 - EXISTING BRITISH TELECOM UTILITIES
UT/002 - EXISTING SEVERN TRENT WATER TRUNK MAIN UTILITIES
Maintenance / Cleaning
Not identified at this stage
Use
Not identified at this stage
Decommissioning / Demolition
Not identified at this stage
DESIGN FIX 2 A1 C02 NG HV AM TT 27/08/21
DESIGN FOR CONSULTATION A1 C03 NG NKRP AM TT 04/11/21
DESIGN FIX 3 A1 C04 MC CJ CCR TT 14/07/22
DESIGN FIX 3 - FINAL A1 C05 MC CJ CCR BM 06/03/23
Bus Lane Update A1 C06 MC NKRP CCR BM 14/06/23
APPROVED - PUBLISHED A1
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M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT GALLAGHER JUCTION SHEET 09 OF 17
GCCM5J10 - ATK - HGN - J4_JN - DR - CH - 000001
A1 Scale: 1:1000 5197035 Sheet 9 of 17 Rev: C06
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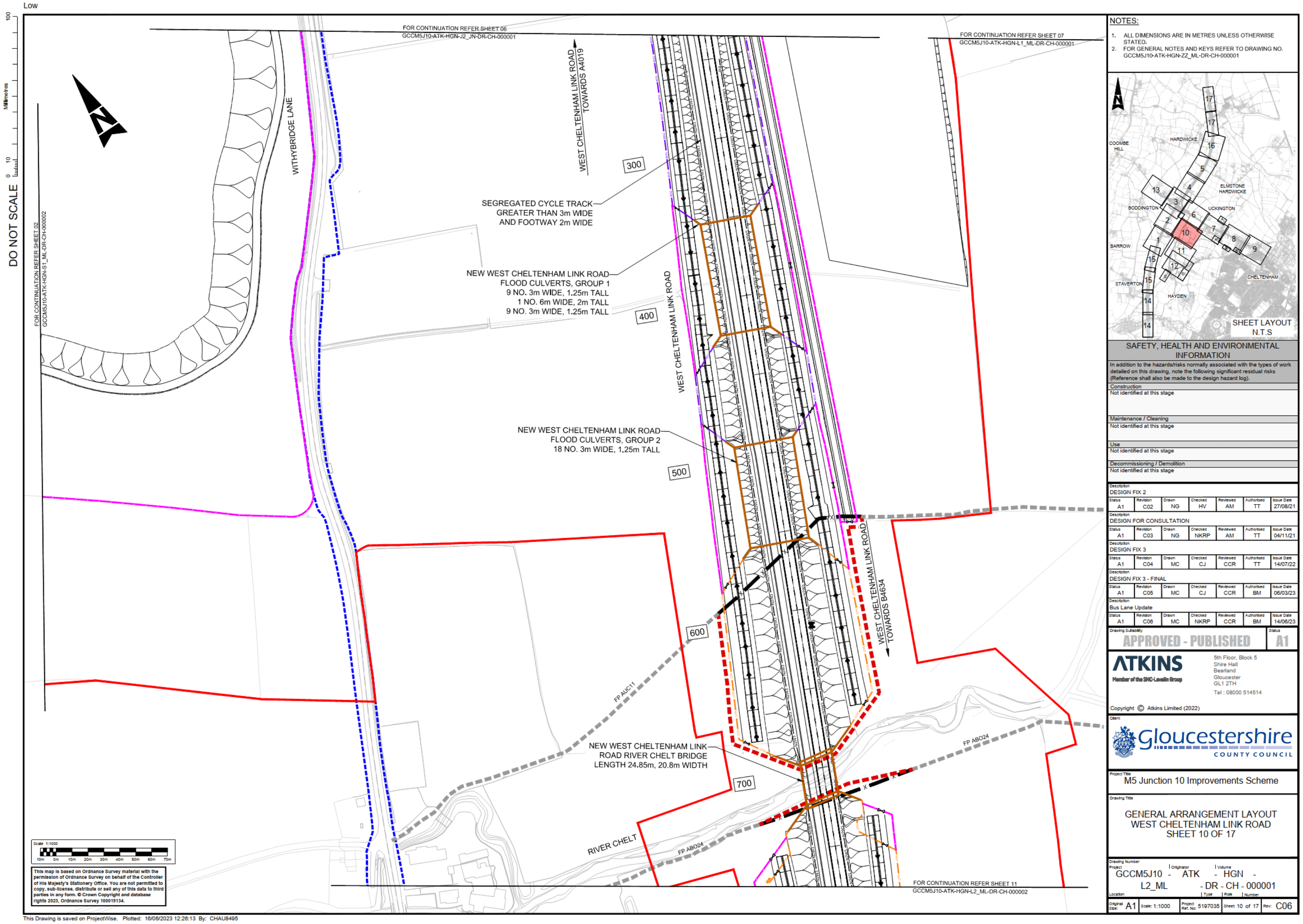
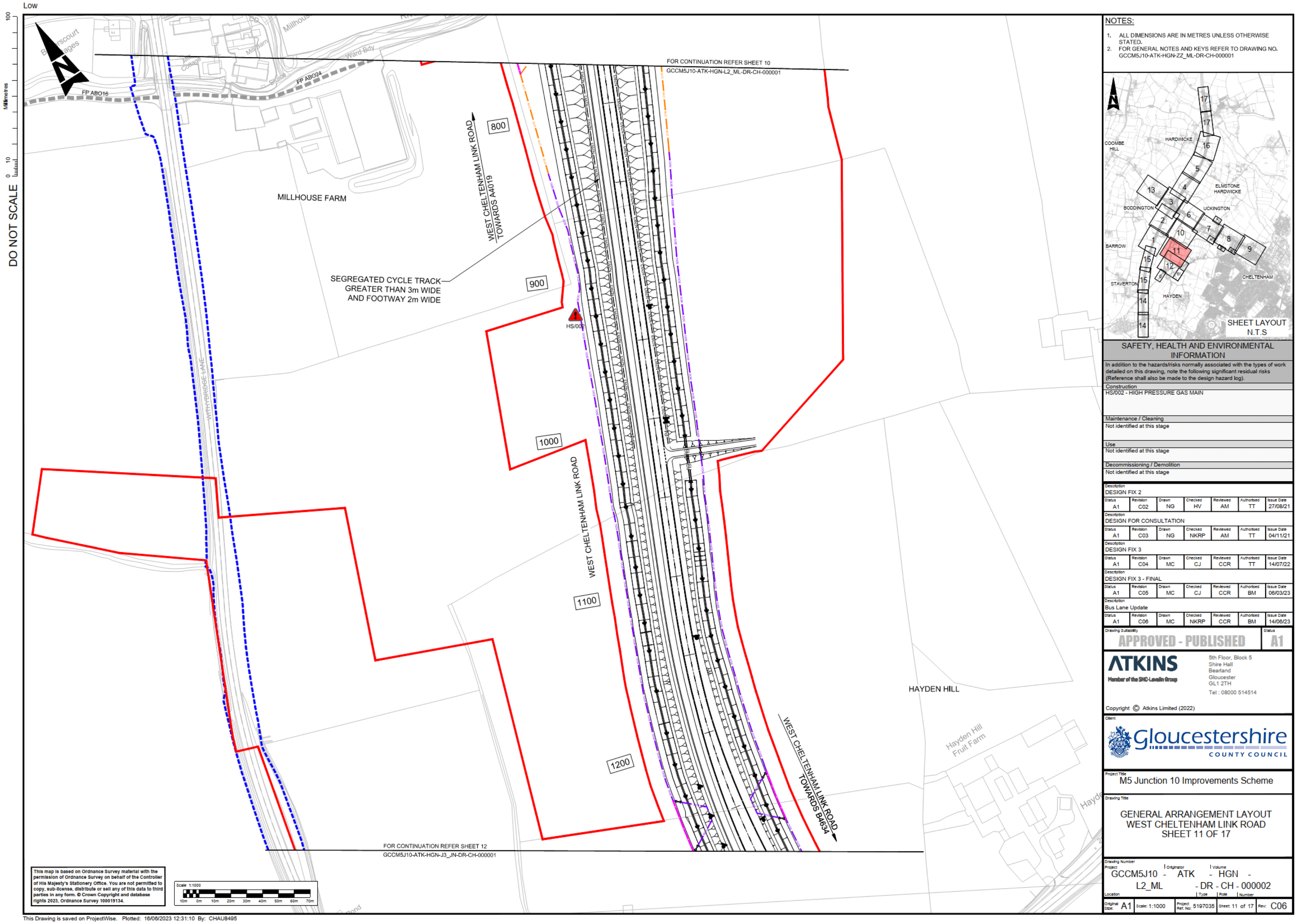

FOR CONTINUATION REFER SHEET 06
GCCM5J10-ATK-HGN-J2_JN-DR-CH-000001
FOR CONTINUATION REFER SHEET 07
GCCM5J10-ATK-HGN-L1_ML-DR-CH-000001
WITHYBRIDGE LANE
WEST CHELTENHAM LINK ROAD TOWARDS A4019
300
400
500
600
700
SEGREGATED CYCLE TRACK GREATER THAN 3m WIDE AND FOOTWAY 2m WIDE
NEW WEST CHELTENHAM LINK ROAD FLOOD CULVERTS, GROUP 1 9 NO. 3m WIDE, 1.25m TALL 1 NO. 6m WIDE, 2m TALL 9 NO. 3m WIDE, 1.25m TALL
WEST CHELTENHAM LINK ROAD
NEW WEST CHELTENHAM LINK ROAD FLOOD CULVERTS, GROUP 2 18 NO. 3m WIDE, 1.25m TALL
WEST CHELTENHAM LINK ROAD TOWARDS B4634
NEW WEST CHELTENHAM LINK ROAD RIVER CHELT BRIDGE LENGTH 24.85m, 20.8m WIDTH
RIVER CHELT
FP AUC11
FP ABO24
FOR CONTINUATION REFER SHEET 11
GCCM5J10-ATK-HGN-L2_ML-DR-CH-000002
FOR CONTINUATION REFER SHEET 02
GCCM5J10-ATK-HGN-S1_ML-DR-CH-000002
DO NOT SCALE
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
Not identified at this stage
APPROVED - PUBLISHED
A1
ATKINS
M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT WEST CHELTENHAM LINK ROAD SHEET 10 OF 17
GCCM5J10 - ATK - HGN - L2_ML - DR - CH - 000001
C06


DO NOT SCALE
MILLHOUSE FARM
WEST CHELTENHAM LINK ROAD TOWARDS A4019
SEGREGATED CYCLE TRACK GREATER THAN 3m WIDE AND FOOTWAY 2m WIDE
FOR CONTINUATION REFER SHEET 10 GCCM5J10-ATK-HGN-L2_ML-DR-CH-000001
800
900
1000
1100
1200
WEST CHELTENHAM LINK ROAD
WEST CHELTENHAM LINK ROAD TOWARDS B4634
HAYDEN HILL
Hayden Hill Fruit Farm
FOR CONTINUATION REFER SHEET 12 GCCM5J10-ATK-HGN-J3_JN-DR-CH-000001
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
HS/002 - HIGH PRESSURE GAS MAIN
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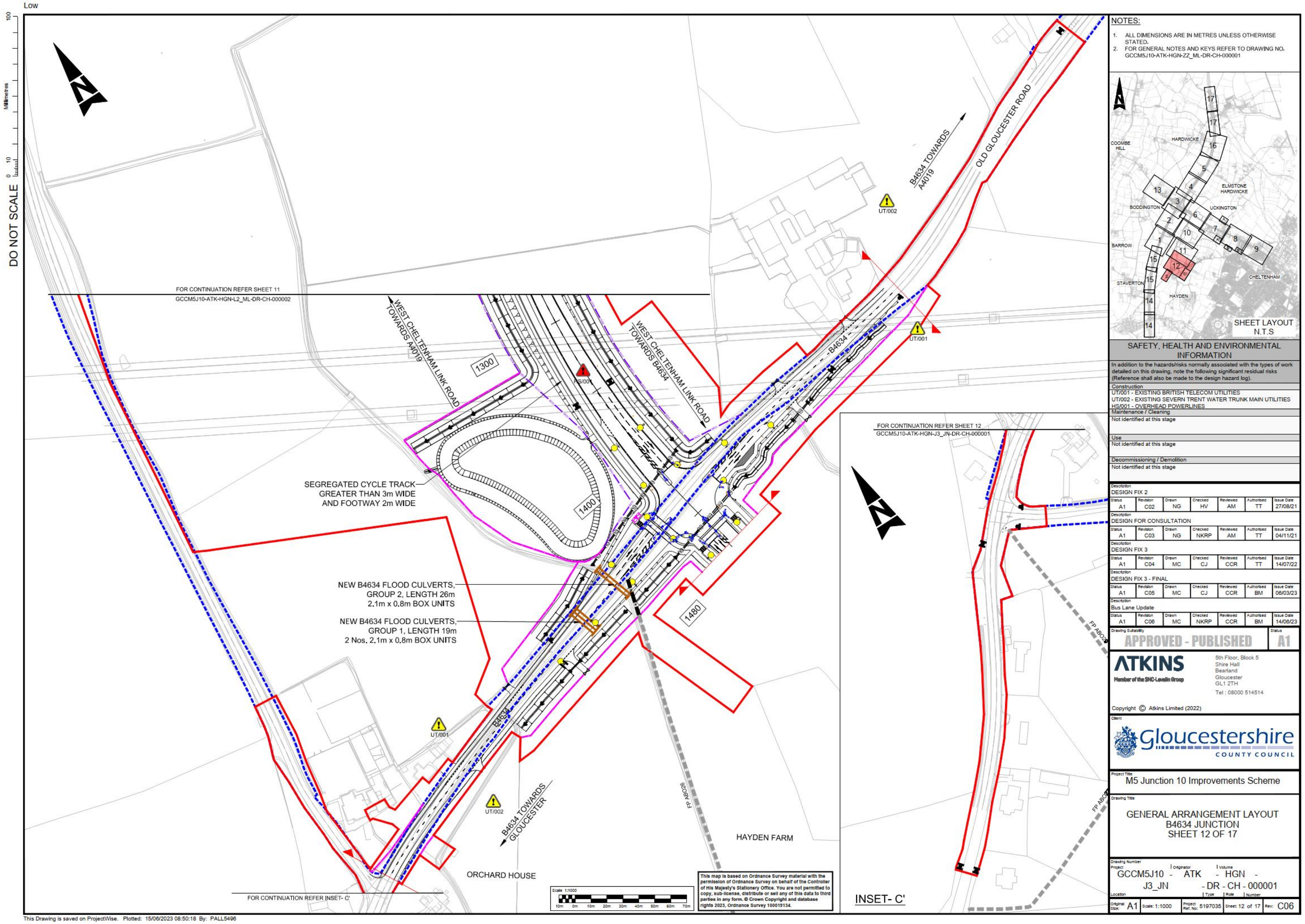
M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
WEST CHELTENHAM LINK ROAD
SHEET 11 OF 17
GCCM5J10 - ATK - HGN - L2_ML - DR - CH - 000002
C06


DO NOT SCALE
NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. FOR GENERAL NOTES AND KEYS REFER TO DRAWING NO. GCCM5J10-ATK-HGN-ZZ_ML-DR-CH-000001
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).
Construction
UT/001 - EXISTING BRITISH TELECOM UTILITIES
UT/002 - EXISTING SEVERN TRENT WATER TRUNK MAIN UTILITIES
HS/001 - OVERHEAD POWERLINES
Maintenance / Cleaning
Not identified at this stage
Use
Not identified at this stage
Decommissioning / Demolition
Not identified at this stage
DESIGN FIX 2
A1 C02 NG HV AM TT 27/08/21
DESIGN FOR CONSULTATION
A1 C03 NG NKRP AM TT 04/11/21
DESIGN FIX 3
A1 C04 MC CJ CCR TT 14/07/22
DESIGN FIX 3 - FINAL
A1 C05 MC CJ CCR BM 06/03/23
Bus Lane Update
A1 C06 MC NKRP CCR BM 14/06/23
APPROVED - PUBLISHED A1
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M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
B4634 JUNCTION
SHEET 12 OF 17
GCCM5J10 - ATK - HGN -
J3_JN - DR - CH - 000001
A1 Scale: 1:1000 5197035 Sheet: 12 of 17 Rev: C06
FOR CONTINUATION REFER SHEET 11
GCCM5J10-ATK-HGN-L2_ML-DR-CH-000002
WEST CHELTENHAM LINK ROAD TOWARDS A4019
WEST CHELTENHAM LINK ROAD TOWARDS B4634
B4634 TOWARDS A4019
OLD GLOUCESTER ROAD
B4634
B4634 TOWARDS GLOUCESTER
1300
1400
1480
UT/001
UT/002
HS/001
SEGREGATED CYCLE TRACK GREATER THAN 3m WIDE AND FOOTWAY 2m WIDE
NEW B4634 FLOOD CULVERTS, GROUP 2, LENGTH 26m 2.1m x 0.8m BOX UNITS
NEW B4634 FLOOD CULVERTS, GROUP 1, LENGTH 19m 2 Nos. 2.1m x 0.8m BOX UNITS
HAYDEN FARM
ORCHARD HOUSE
FOR CONTINUATION REFER INSET- C'
FOR CONTINUATION REFER SHEET 12
GCCM5J10-ATK-HGN-J3_JN-DR-CH-000001
INSET- C'
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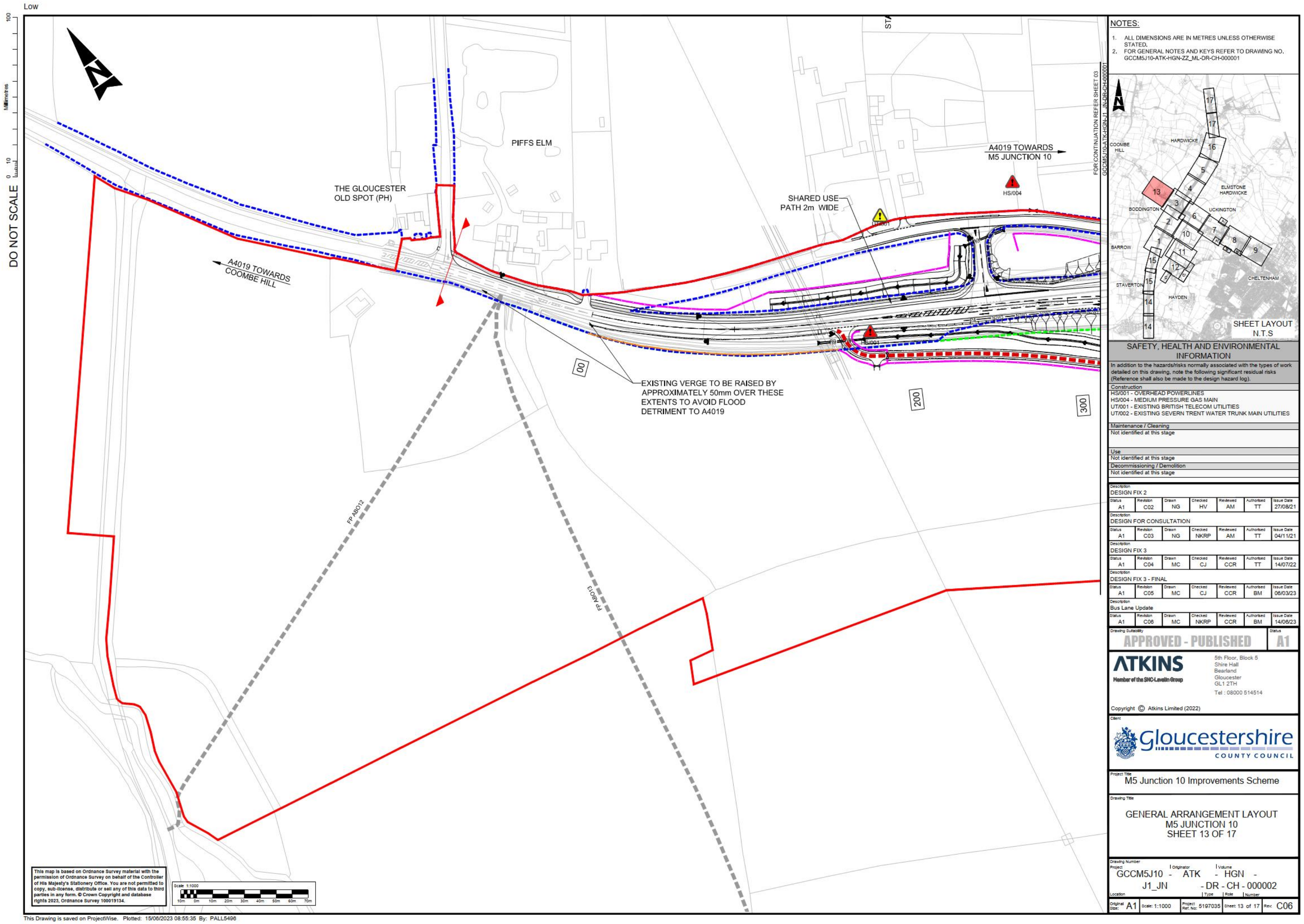
DO NOT SCALE
PIFFS ELM
THE GLOUCESTER OLD SPOT (PH)
A4019 TOWARDS COOMBE HILL
A4019 TOWARDS M5 JUNCTION 10
SHARED USE PATH 2m WIDE
HS/004
EXISTING VERGE TO BE RAISED BY APPROXIMATELY 50mm OVER THESE EXTENTS TO AVOID FLOOD DETRIMENT TO A4019
100
200
300
FP ABO12
FOR CONTINUATION REFER SHEET 03
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HARDWICKE
ELMSTONE HARDWICKE
BODDINGTON
UCKINGTON
BARROW
STAVERTON
HAYDEN
CHELTENHAM
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
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HS/001 - OVERHEAD POWERLINES
HS/004 - MEDIUM PRESSURE GAS MAIN
UT/001 - EXISTING BRITISH TELECOM UTILITIES
UT/002 - EXISTING SEVERN TRENT WATER TRUNK MAIN UTILITIES
Maintenance / Cleaning
Not identified at this stage
Use
Not identified at this stage
Decommissioning / Demolition
Not identified at this stage
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DESIGN FOR CONSULTATION A1 C03 NG NKRP AM TT 04/11/21
DESIGN FIX 3 A1 C04 MC CJ CCR TT 14/07/22
DESIGN FIX 3 - FINAL A1 C05 MC CJ CCR BM 06/03/23
Bus Lane Update A1 C06 MC NKRP CCR BM 14/06/23
APPROVED - PUBLISHED A1
ATKINS
5th Floor, Block 5 Shire Hall Bearland Gloucester GL1 2TH
Tel : 08000 514514
Copyright © Atkins Limited (2022)
Gloucestershire COUNTY COUNCIL
M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
M5 JUNCTION 10
SHEET 13 OF 17
GCCM5J10 - ATK - HGN - J1_JN - DR - CH - 000002
A1 Scale: 1:1000 5197035 Sheet 13 of 17 Rev: C06
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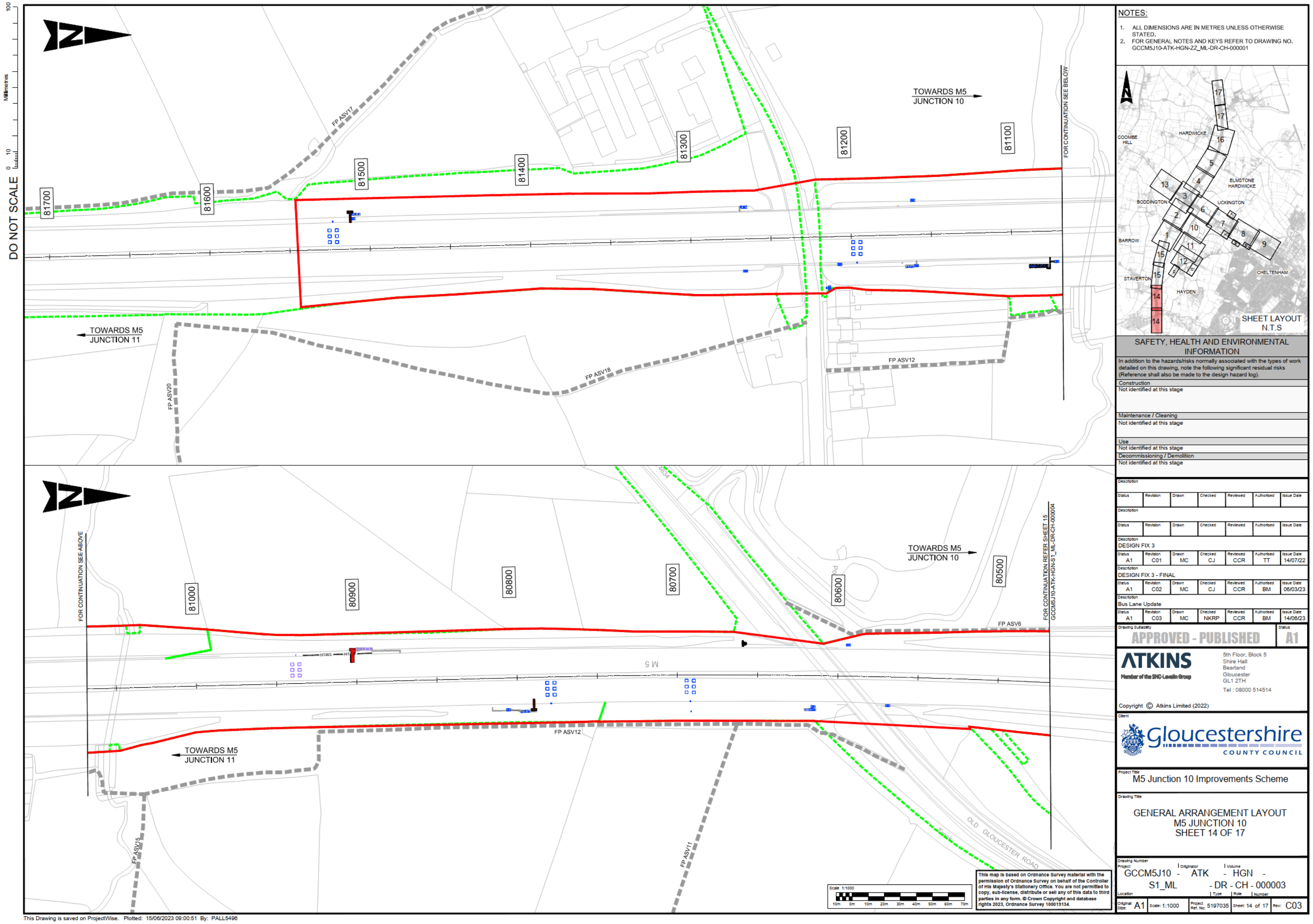
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81400
81300
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FP ASV18
FP ASV20
FP ASV12
TOWARDS M5 JUNCTION 10
TOWARDS M5 JUNCTION 11
FOR CONTINUATION SEE BELOW
FOR CONTINUATION SEE ABOVE
81000
80900
80800
80700
80600
80500
FP ASV6
FP ASV15
FP ASV11
M5
OLD GLOUCESTER ROAD
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
Not identified at this stage
DESIGN FIX 3
DESIGN FIX 3 - FINAL
Bus Lane Update
APPROVED - PUBLISHED
A1
ATKINS
Gloucestershire COUNTY COUNCIL
M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
M5 JUNCTION 10
SHEET 14 OF 17
GCCM5J10 - ATK - HGN - S1_ML - DR - CH - 000003
Scale: 1:1000
C03


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TOWARDS M5 JUNCTION 11
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FOR CONTINUATION SEE ABOVE
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80000
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79700
79600
79500
79400
FP ASV6
M 5
HS/001
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
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HS/001 - OVERHEAD POWERLINES
Maintenance / Cleaning
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Use
Not identified at this stage
Decommissioning / Demolition
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DESIGN FIX 3 - FINAL
A1 C02 MC CJ CCR BM 06/03/23
Bus Lane Update
A1 C03 MC NKRP CCR BM 14/06/23
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M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
M5 JUNCTION 10
SHEET 15 OF 17
GCCM5J10 - ATK - HGN - S1_ML - DR - CH - 000004
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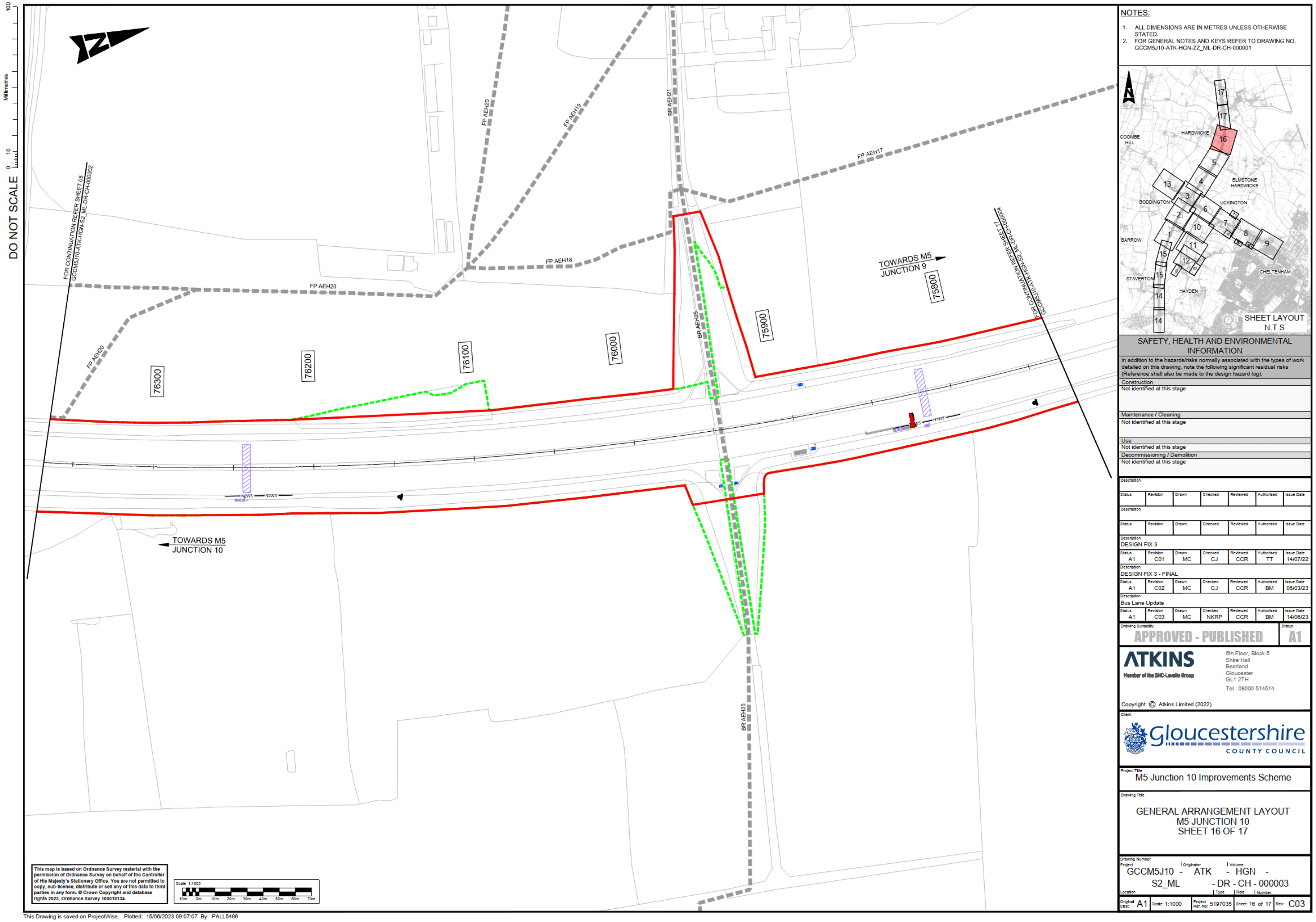
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SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
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TOWARDS M5 JUNCTION 10
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FP AEH19
FP AEH17
BR AEH21
BR AEH25
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76100
76000
75900
75800
DESIGN FIX 3
DESIGN FIX 3 - FINAL
Bus Lane Update
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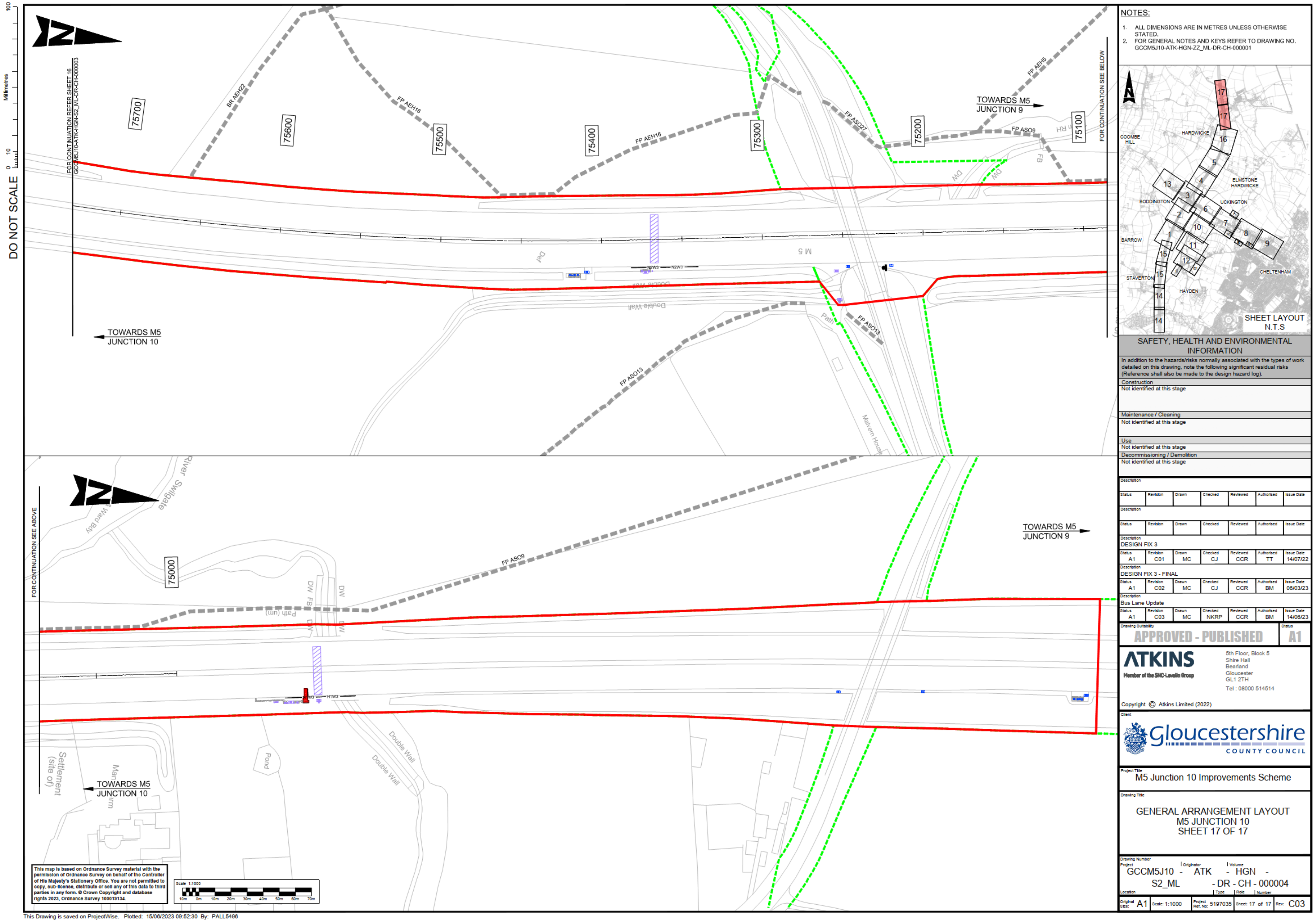
ATKINS
M5 Junction 10 Improvements Scheme
GENERAL ARRANGEMENT LAYOUT
M5 JUNCTION 10
SHEET 16 OF 17
GCCM5J10 - ATK - HGN -
S2_ML - DR - CH - 000003
C03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TOWARDS M5 JUNCTION 10
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75500
75400
75300
75200
75100
75000
FP AEH16
FP ASO9
FP ASO13
FP AEH5
M 5
FOR CONTINUATION SEE BELOW
FOR CONTINUATION SEE ABOVE
SHEET LAYOUT N.T.S
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
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Construction
Not identified at this stage
Maintenance / Cleaning
Not identified at this stage
Use
Not identified at this stage
Decommissioning / Demolition
Not identified at this stage
DESIGN FIX 3
A1 C01 MC CJ CCR TT 14/07/22
DESIGN FIX 3 - FINAL
A1 C02 MC CJ CCR BM 06/03/23
Bus Lane Update
A1 C03 MC NKRP CCR BM 14/06/23
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M5 JUNCTION 10
SHEET 17 OF 17
GCCM5J10 - ATK - HGN - S2_ML - DR - CH - 000004
A1
Scale: 1:1000
5197035
Sheet 17 of 17
C03
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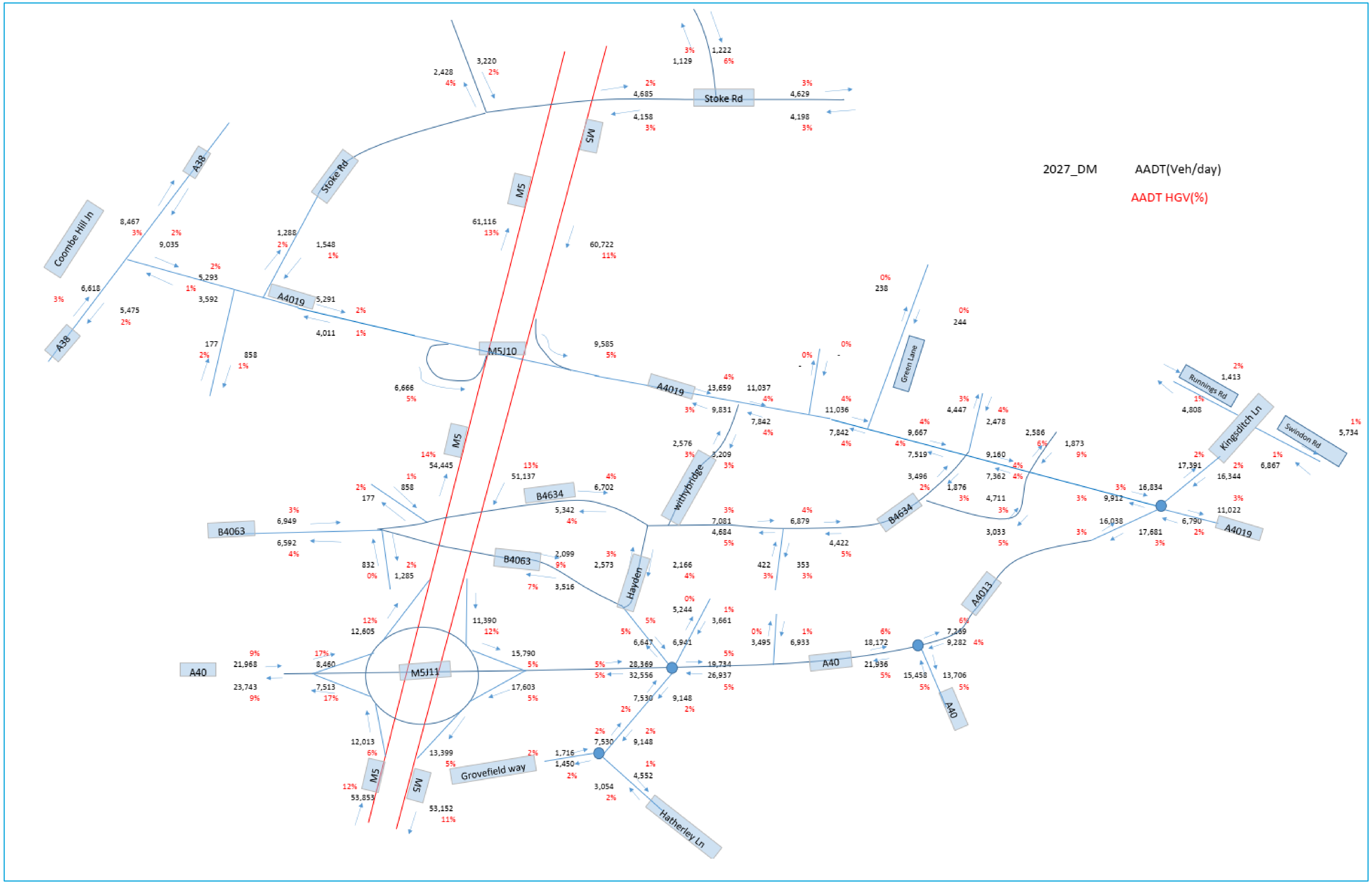
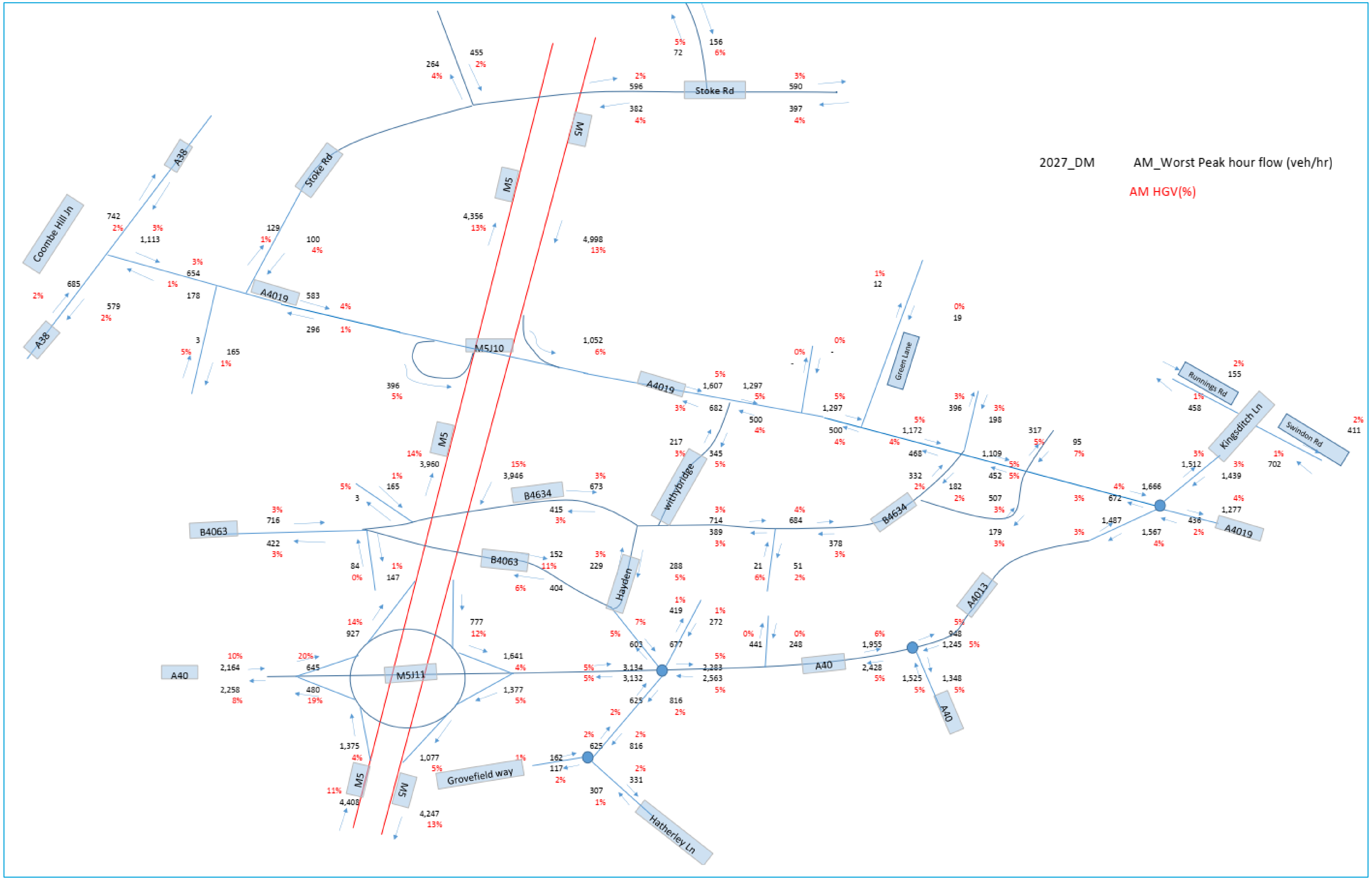
Appendix D. J10 Data to design team (Worst peak flow analysis)

2027 DM AADT and %HGV - Scenario P



2027 DM AM Worst Peak Hour Flows and %HGV- Scenario P



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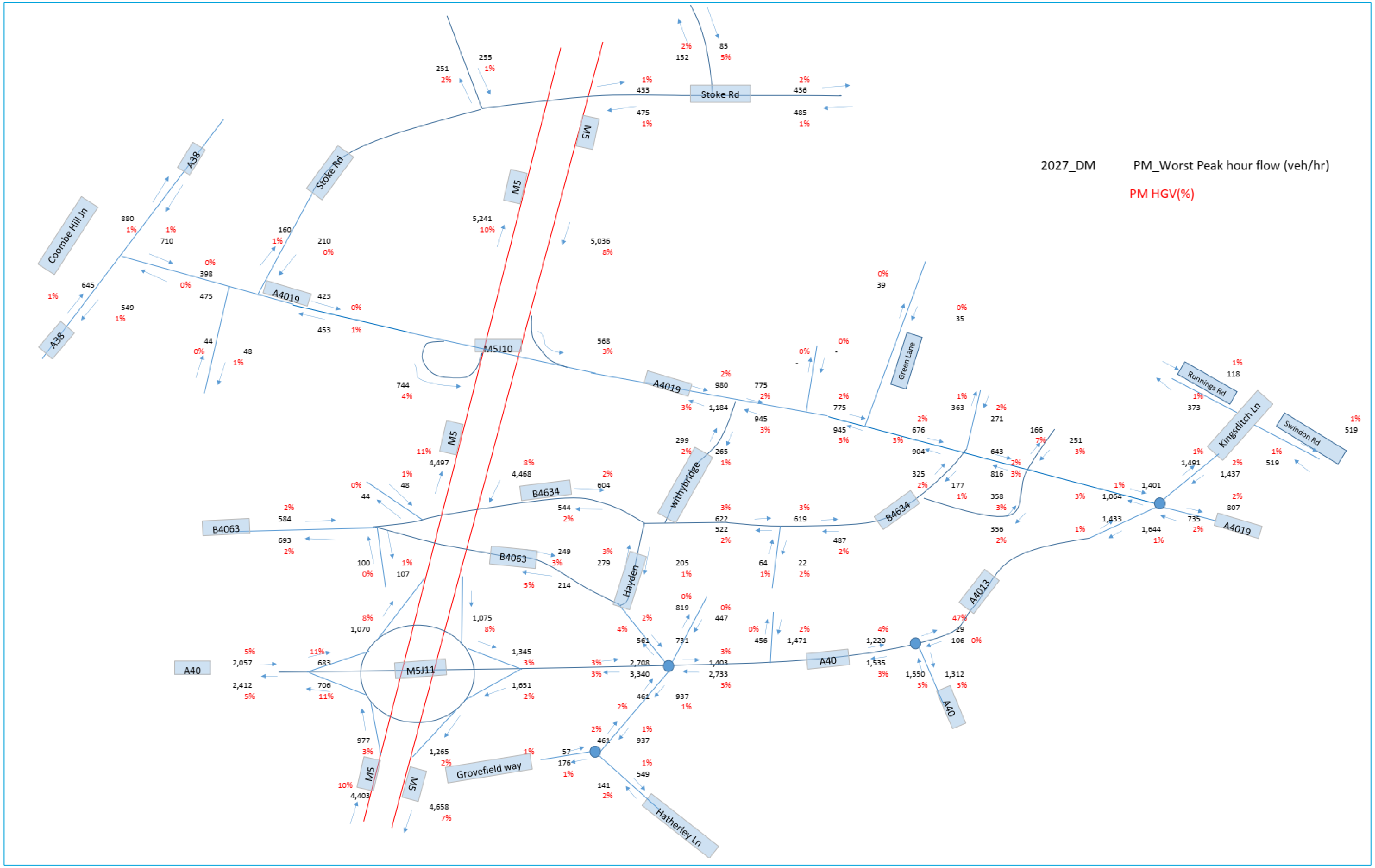

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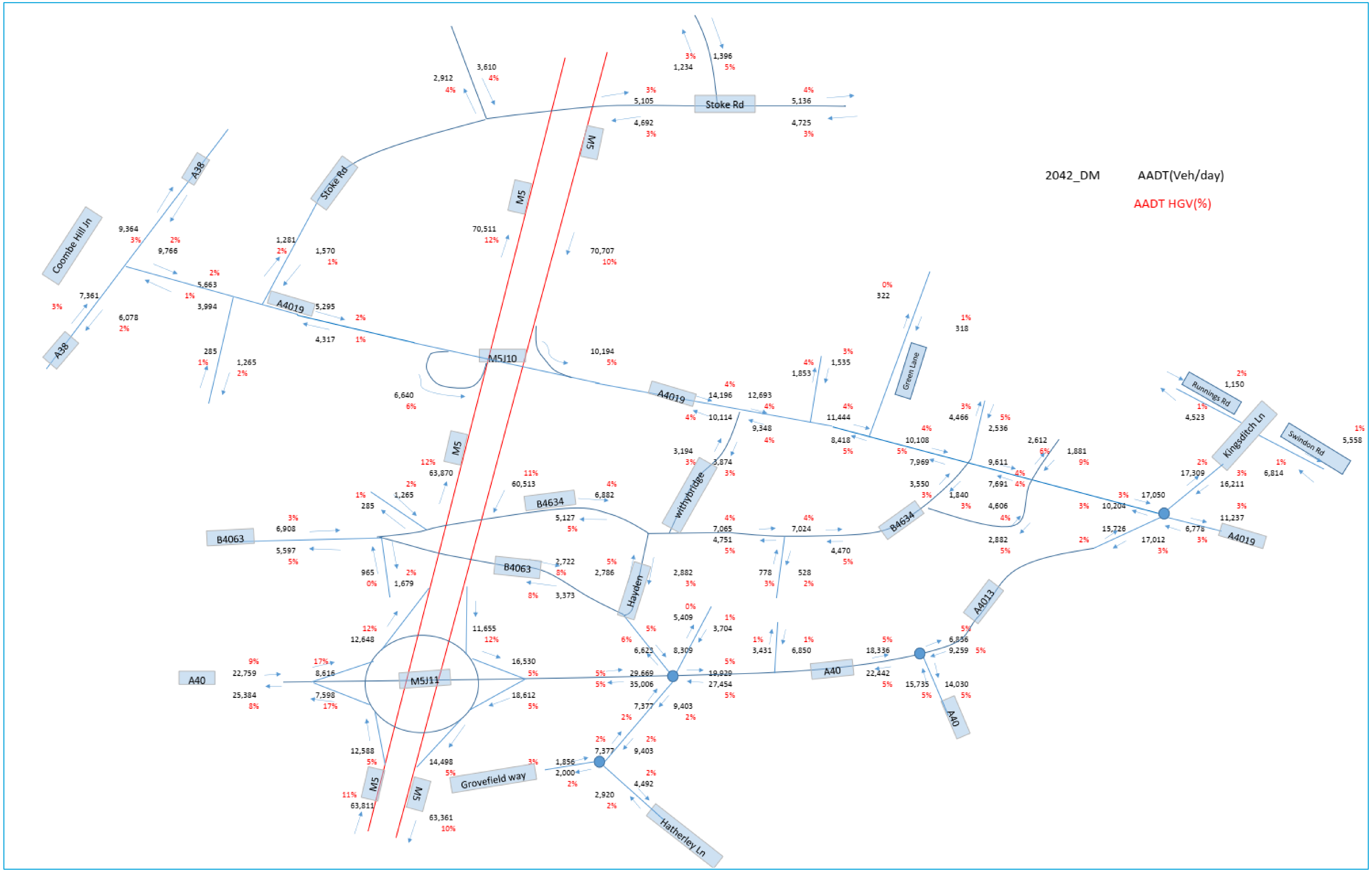

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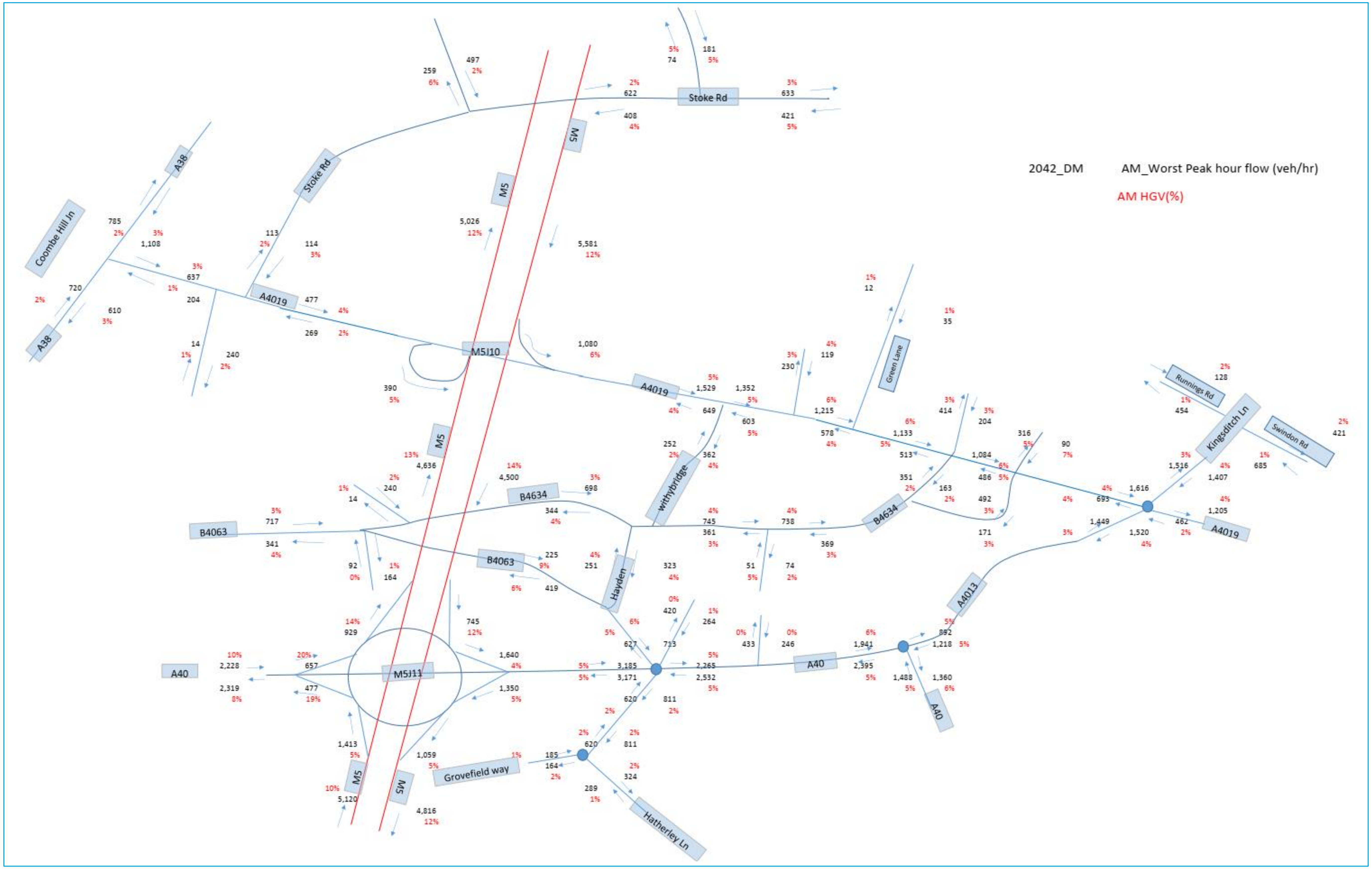

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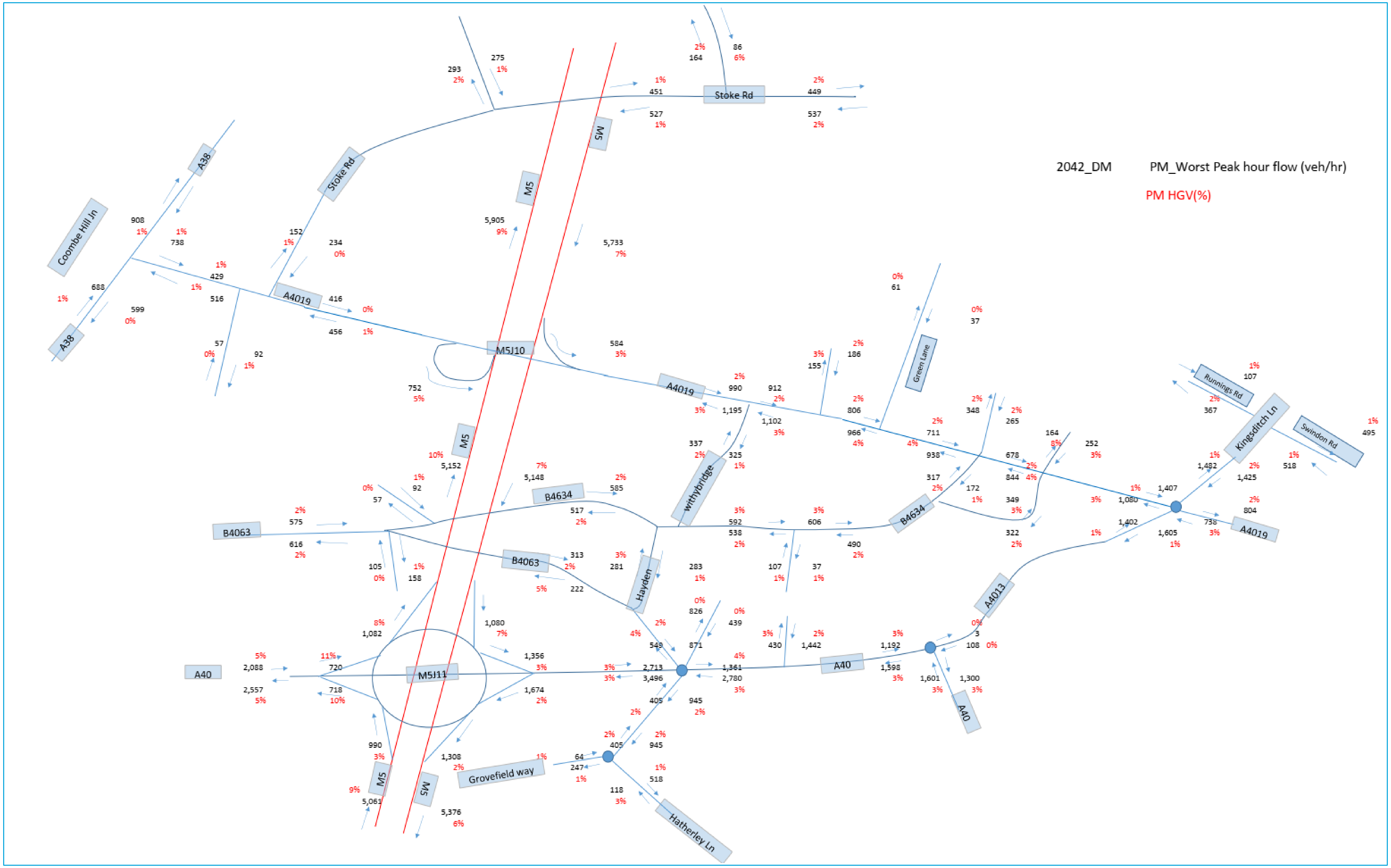

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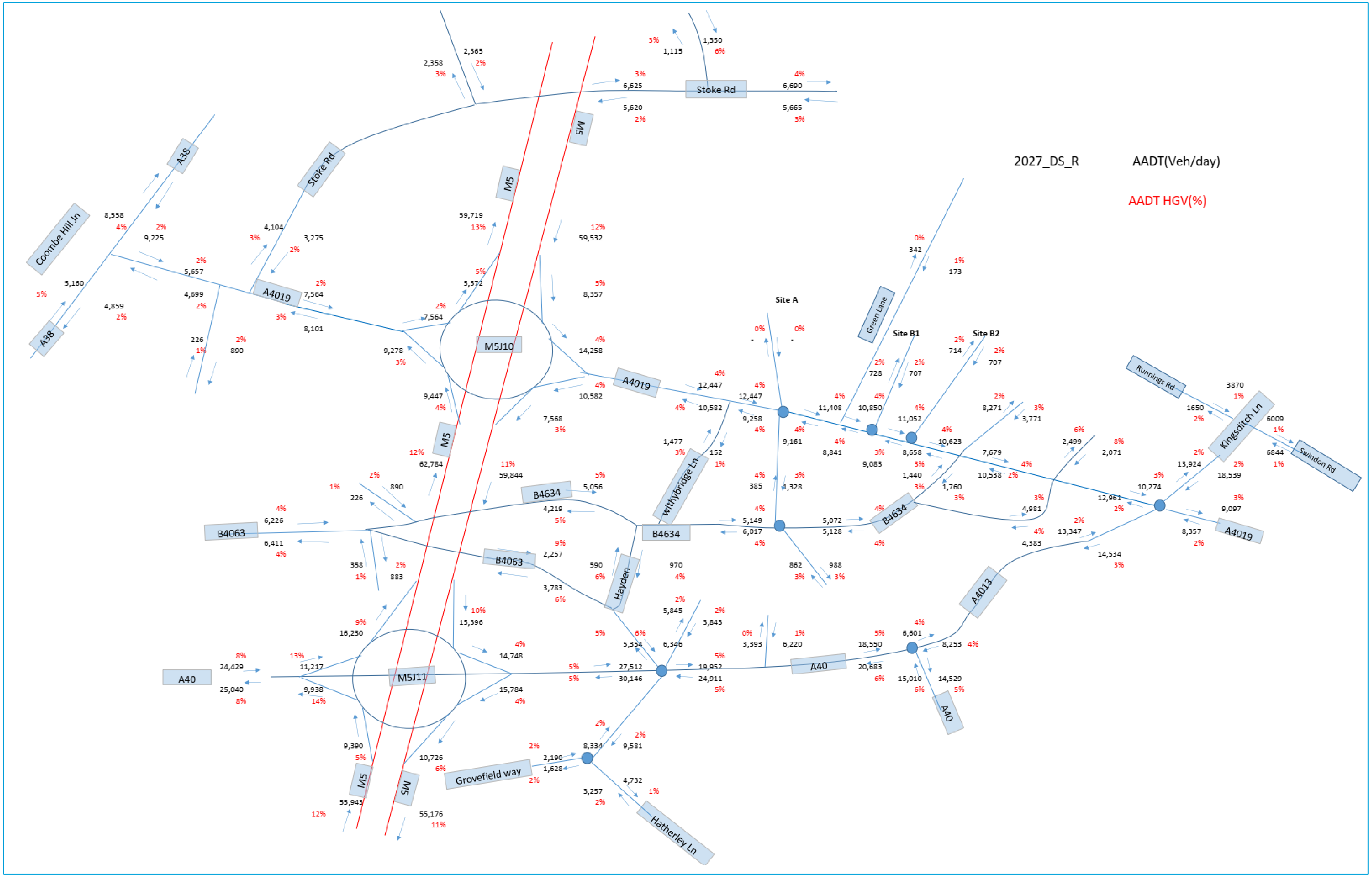

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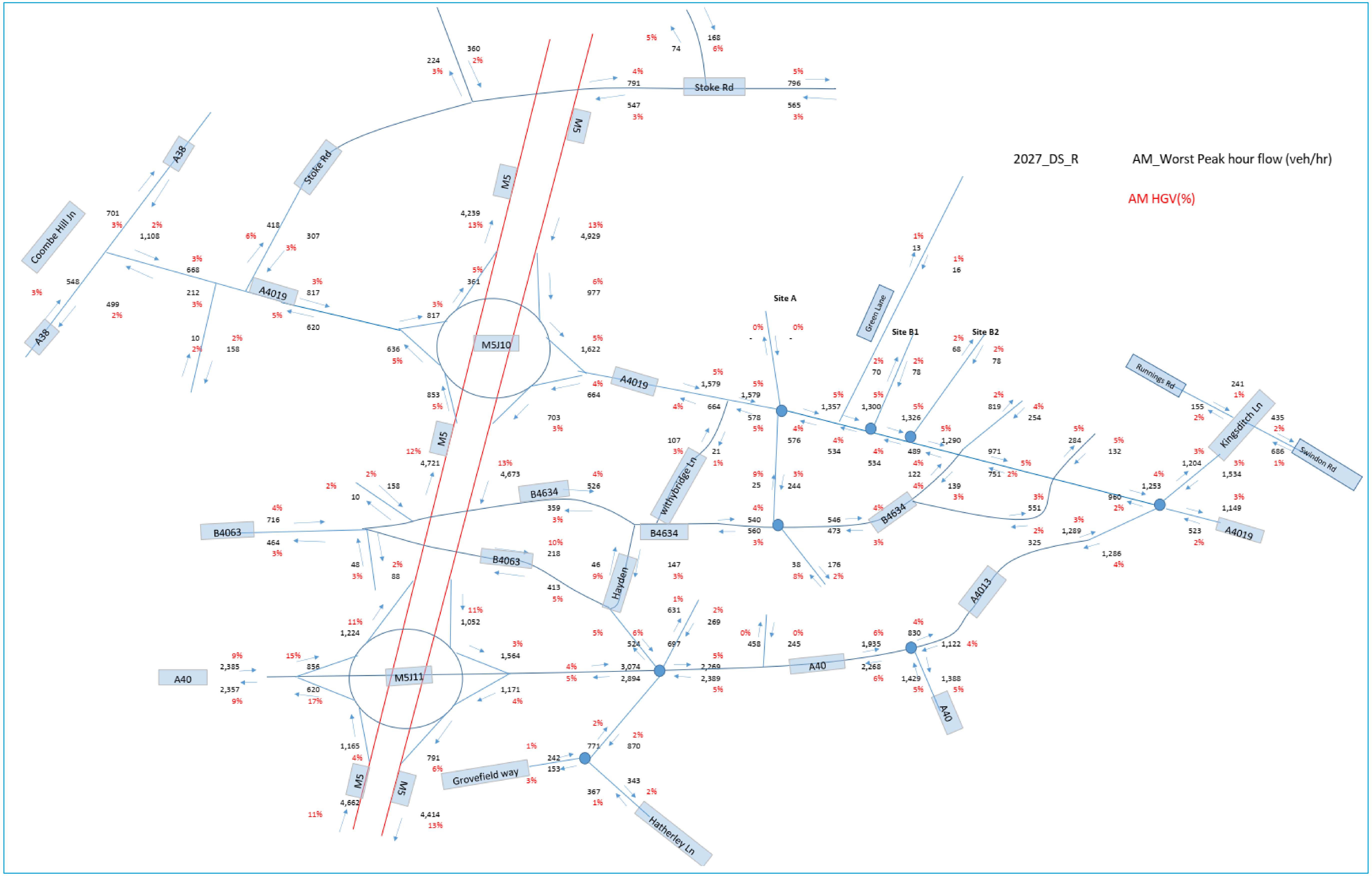

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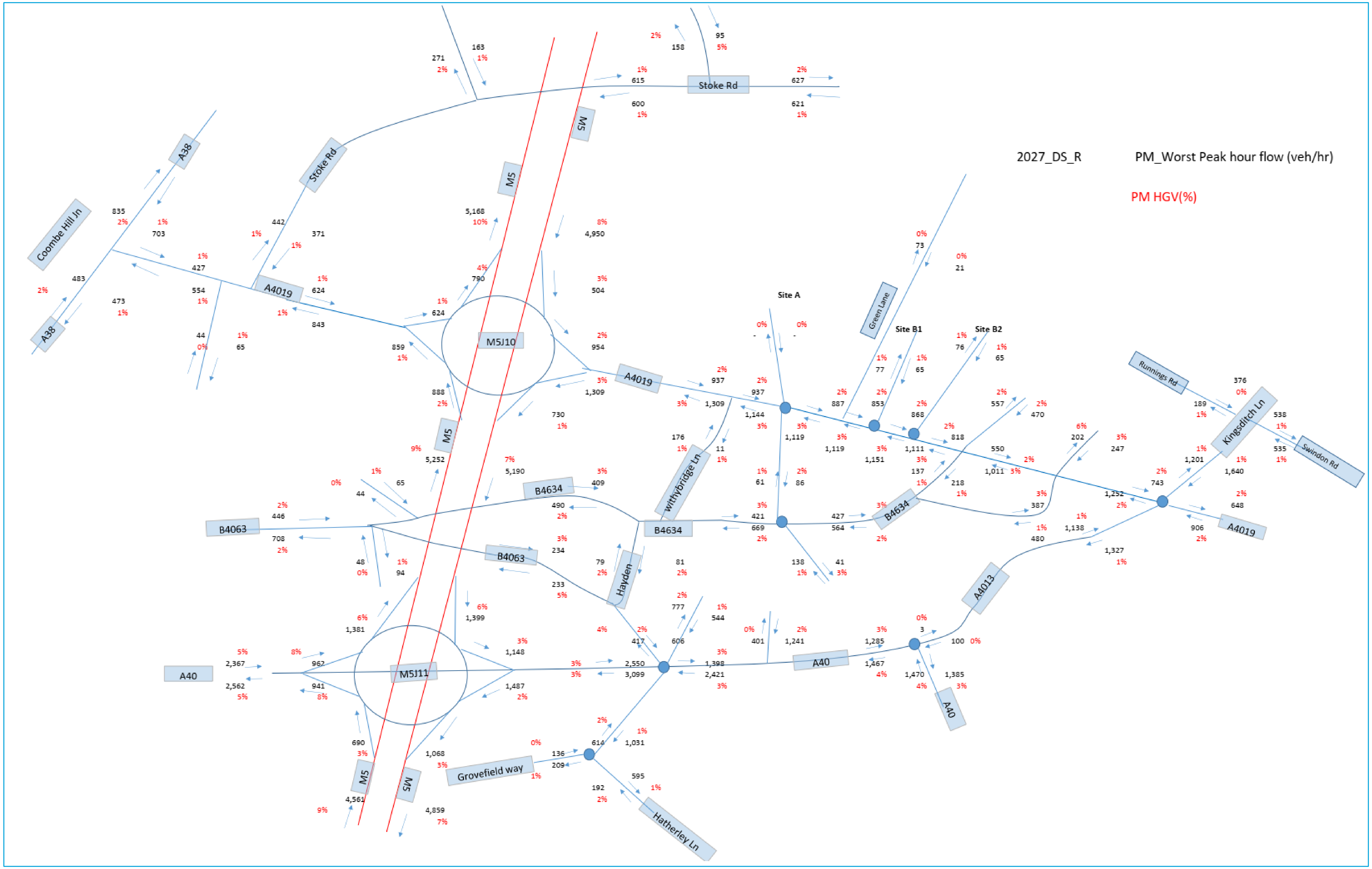

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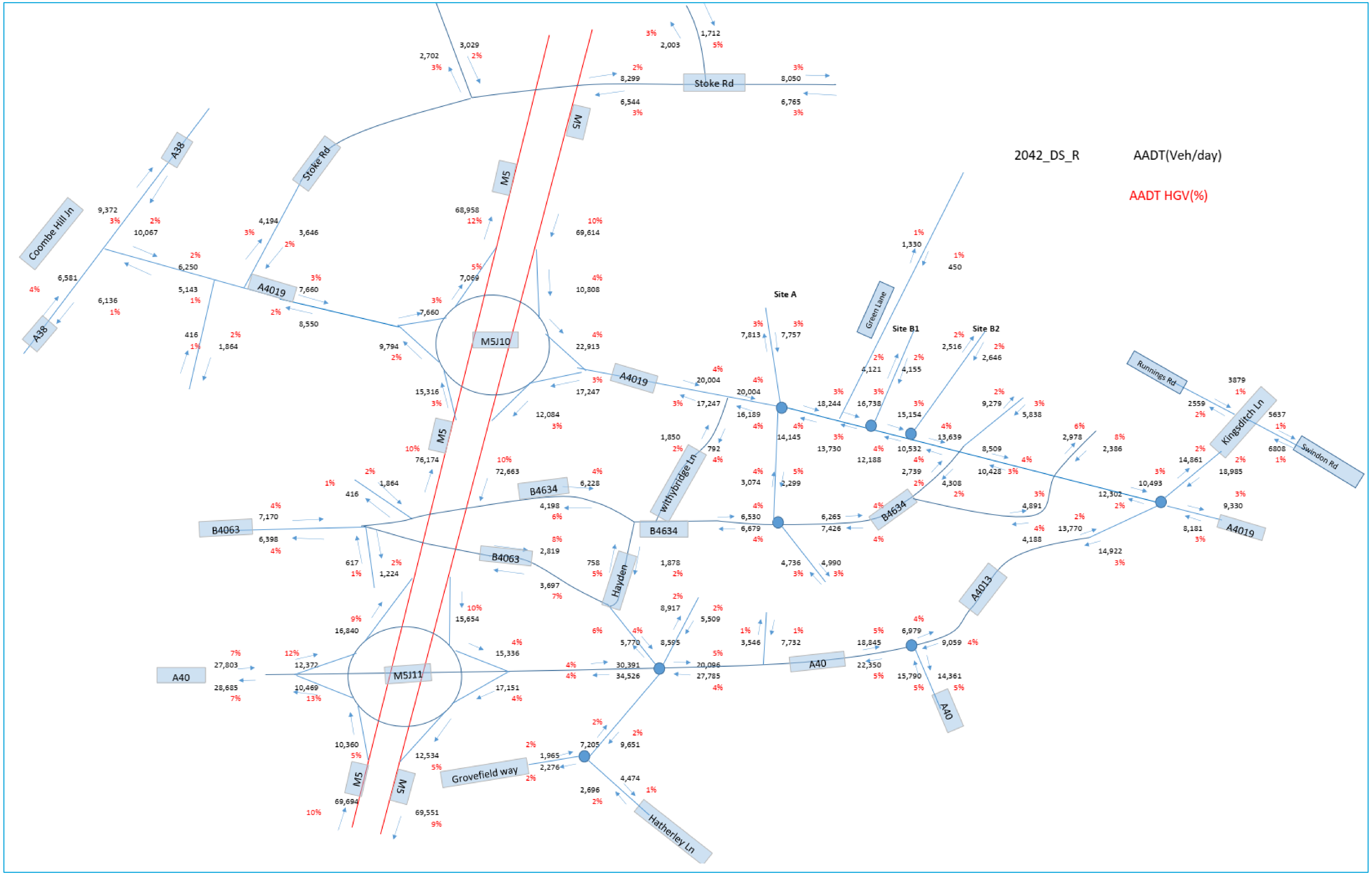
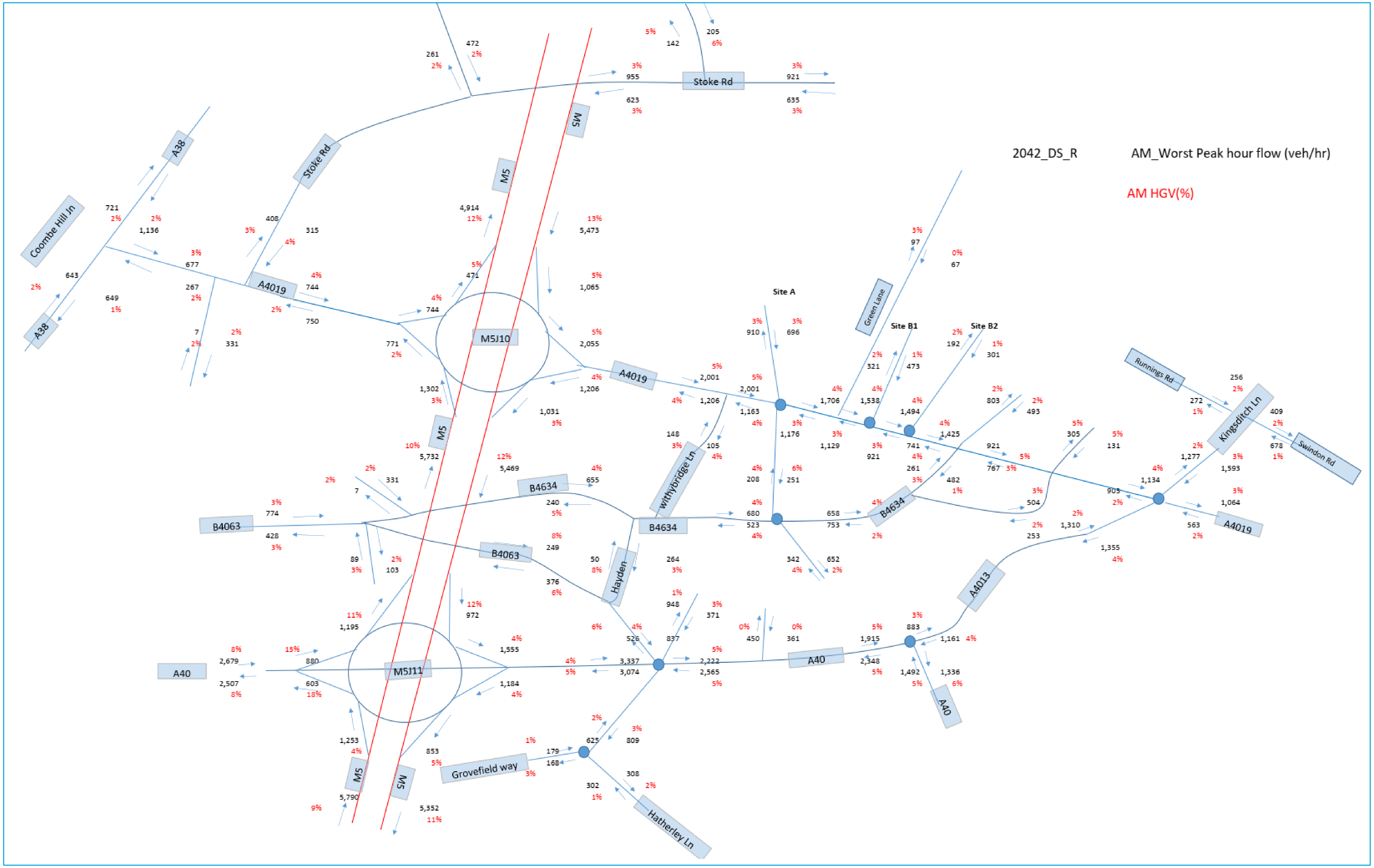


2042 DS AM Worst Peak Hour Flows and %HGV- Scenario R



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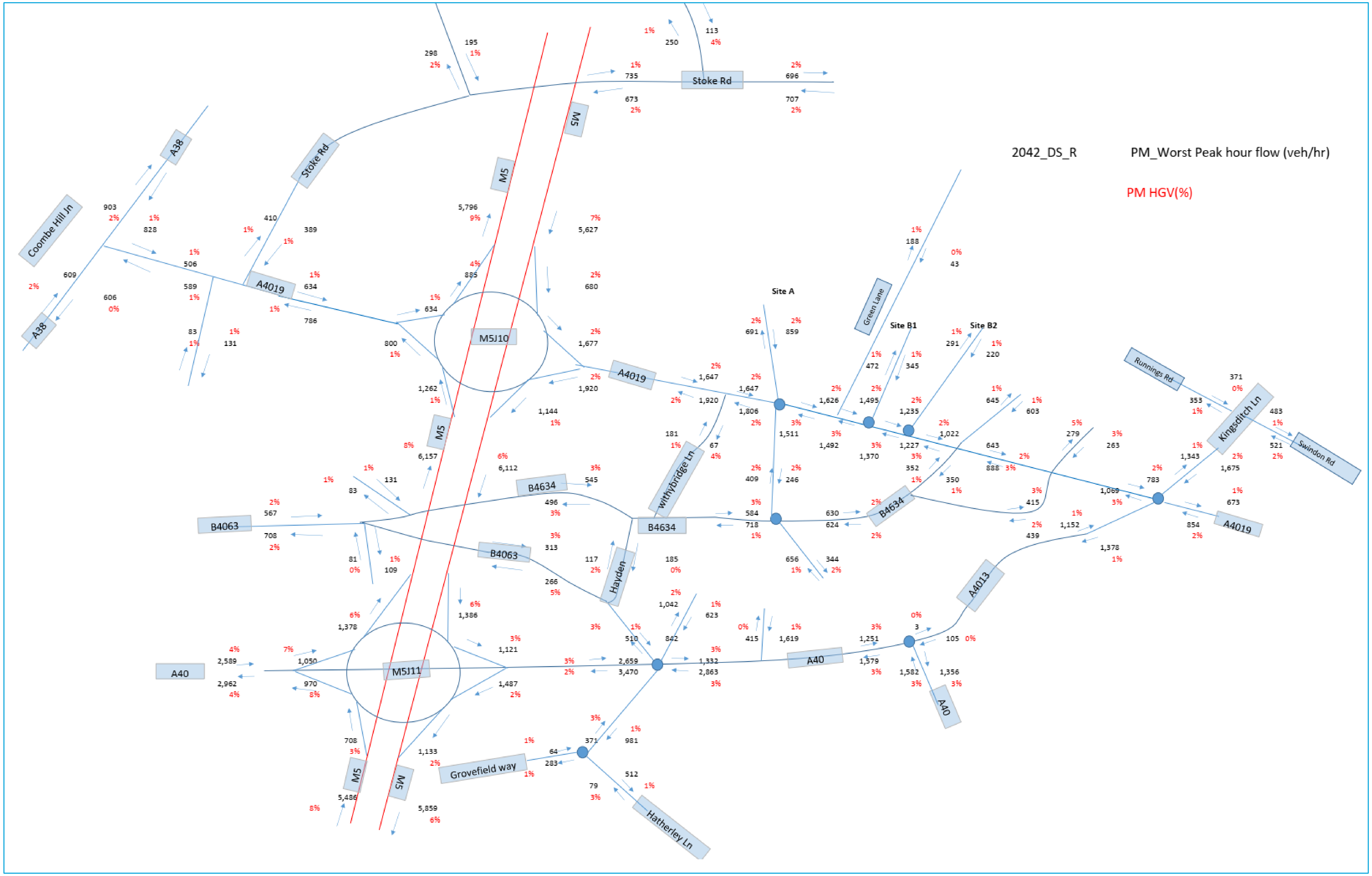

Appendix E. Additional Scenarios and Dependency Tests Technical Note

E.1. Introduction

E.1.1. Whilst the main body of the Traffic Forecasting Report (TFR) includes the comparison of the most likely scenarios i.e. P v R which measures the combined impact of the full development and proposed scheme on the highway network, this appendix contains the comparison of two other scenario namely P v Q and R v Q which are outlined in Sections E.2 and E.3 of the note.

E.1.2. In addition, Section E.3 of this appendix includes a summary of the key network statistics the various scenarios. Finally, Section E.4 of this appendix contains the details of the dependency test originally undertaken for the HIF submission in 2019 as well as the results of two sensitivity tests for establishing the impact of varying the quantum of the deadweight development on the economic performance of the proposed M5 J10 scheme as measured by the overall Benefit Cost Ratio (BCR).

E.2. Traffic Modelling Scenarios

E.2.1. There are two main forecast assessment years coinciding with the intended opening year (2027) and design year (2042) of the proposed scheme.

E.2.2. The strategic model which was developed using SATURN suite of software covers the following scenarios:

- Scenario P – Without dependent development (but including deadweight) and without transport scheme
- Scenario Q – With dependent development (including deadweight) and without transport scheme
- Scenario R – With dependent development (including deadweight) and with transport scheme
- Scenario S – Without dependent development (but including deadweight) and with transport scheme

E.2.3. Deadweight is the amount of the development that can occur within the three development sites without the M5 J10 scheme (the transport scheme) in place.

E.2.4. Dependent development is the amount of the development that is reliant on the M5 Junction 10 scheme.

E.2.5. The three proposed JCS sites are planned to be developed over a 15-year span between 2027 (opening year of the M5 J10 proposed scheme) and 2042. The traffic forecast models developed in SATURN suite of software for 2042 under Scenarios Q, P and R were used to undertake the additional analysis for scenarios P v Q and R v Q reported in this appendix.

E.3. Comparison of Scenarios Q, P and R

Overview

E.3.1. The proposed three Joint Core Strategy (JCS) developments are to be fully built out by 2042 which is also the design year of the proposed scheme. All the comparisons in this appendix have been prepared for the design year for the modelled AM and PM peak hours.

E.3.2. Analysis reported in this appendix include difference plots of traffic flows and delays in the area of focus for Scenarios Q v P, and Scenarios R v Q.

E.3.3. In addition, Volume over Capacity (V/C) ratios plots have been produced and compared for the above mentioned scenarios across the focus area to provide further understanding of the changes in congestion under various scenarios.

E.3.4. The comparison of Scenarios Q v P shows the impact of full JCS developments on the network without the presence of the proposed M5 J10 scheme whilst comparison of Scenarios R and Q displays the impact of provision of the proposed M5 J10 Scheme against the same demand.

Traffic Flows, Delays and Capacity Analysis

E.3.5. The traffic flow and delay difference plots as well as link capacity analysis using V/C ratios representing the AM and PM peak modelled hours in 2042 for the two scenarios (Q v P, and R v Q) are provided in Figures E1 to E12 below. The key findings from these figures are outlined in the end of section E.3.

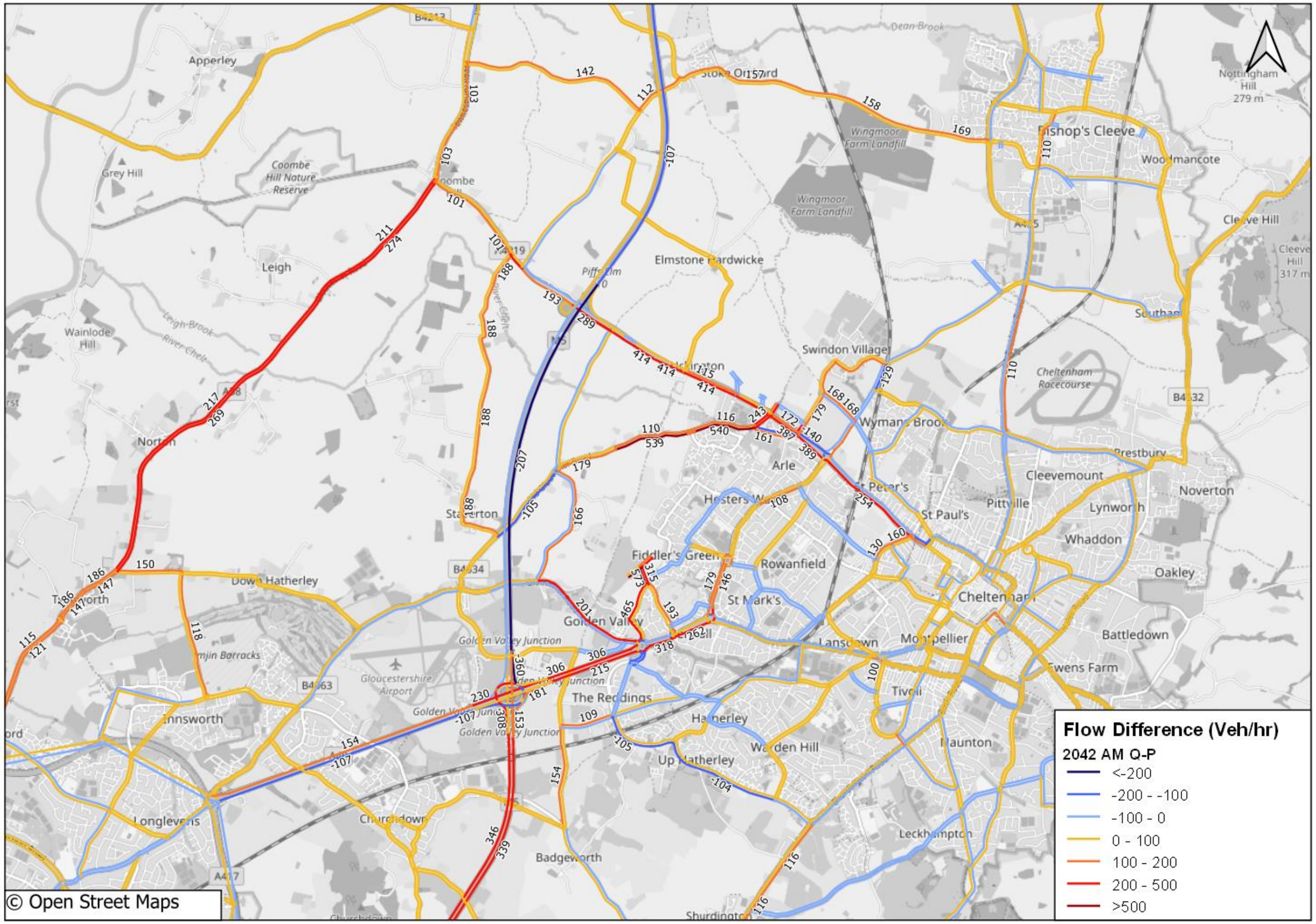

Figure E1 - Traffic Flow Difference Plot - 2042 Q vs P AM Peak

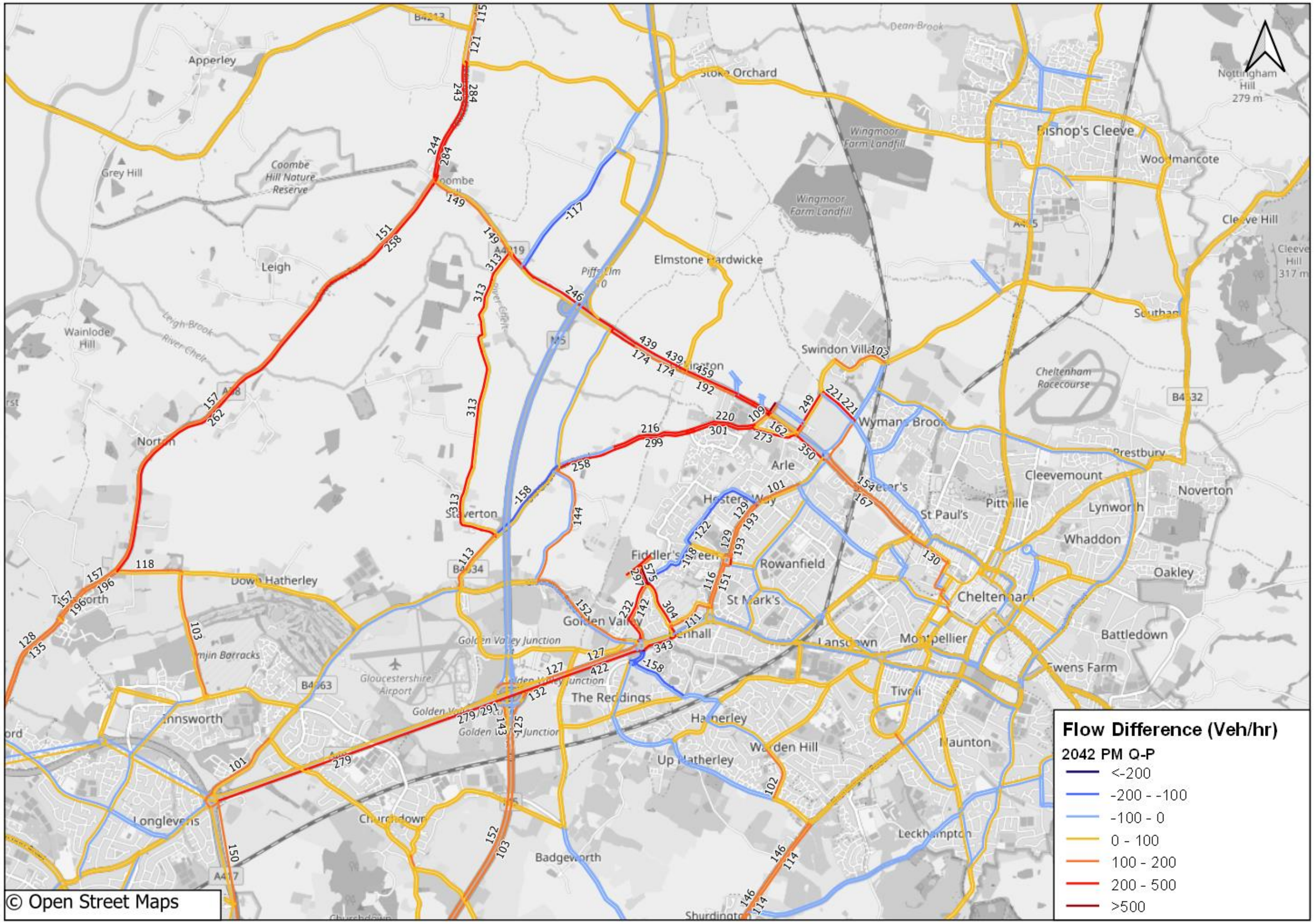

Figure E2 - Traffic Flow Difference Plot - 2042 Q vs P PM Peak

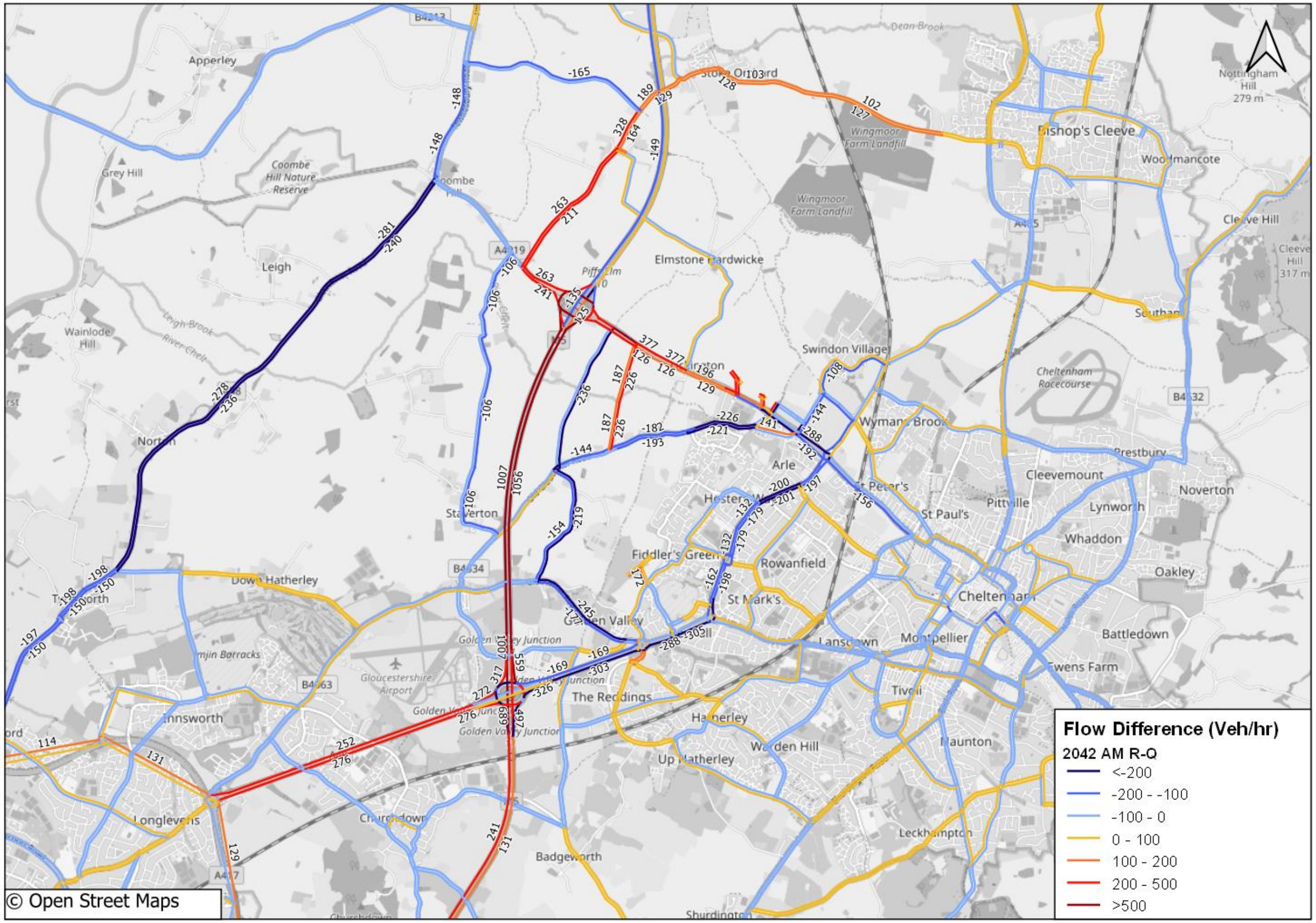

Figure E3 - Traffic Flow Difference Plot - 2042 R vs Q AM Peak

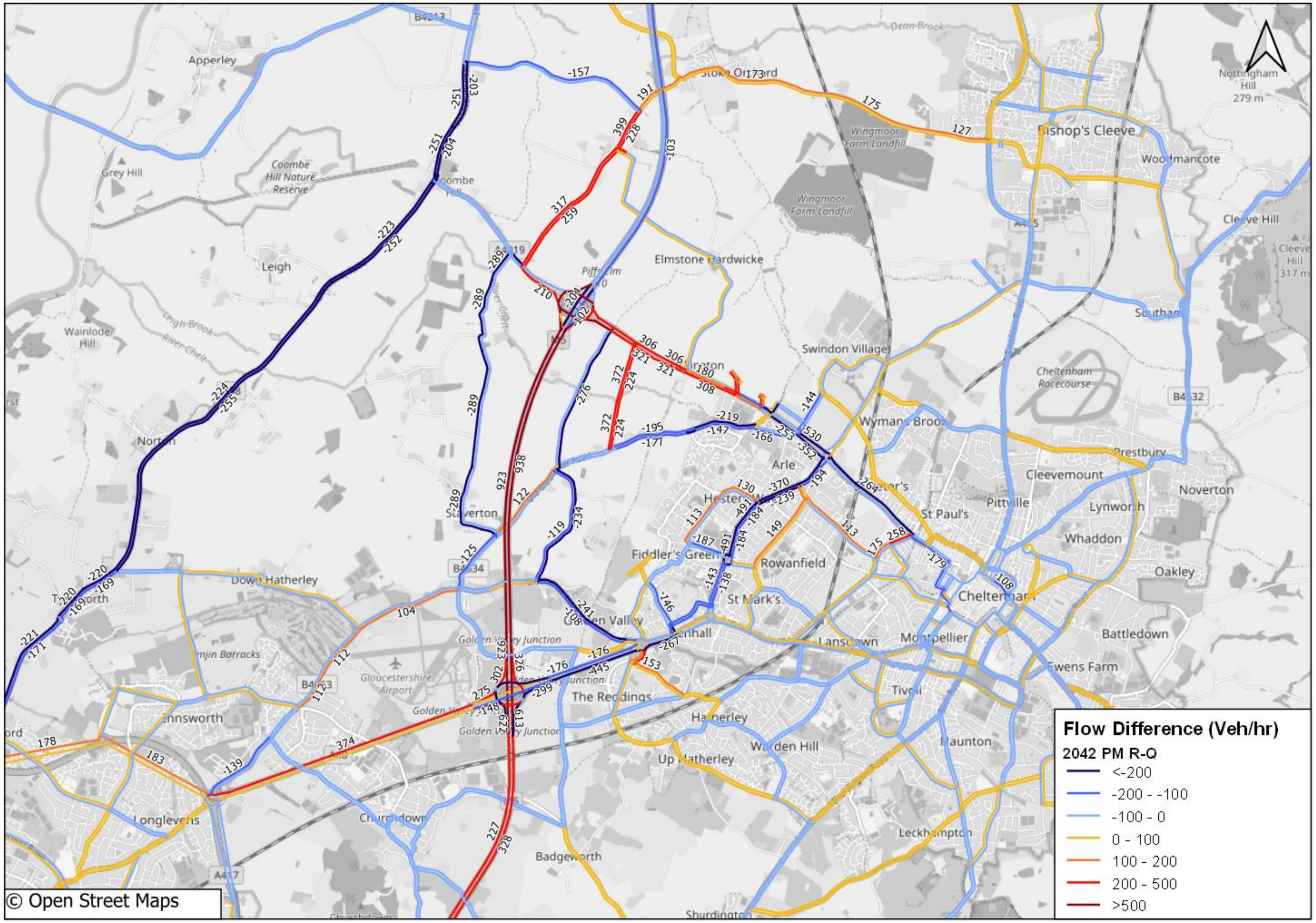

Figure E4 - Traffic Flow Difference Plot - 2042 R vs Q PM Peak

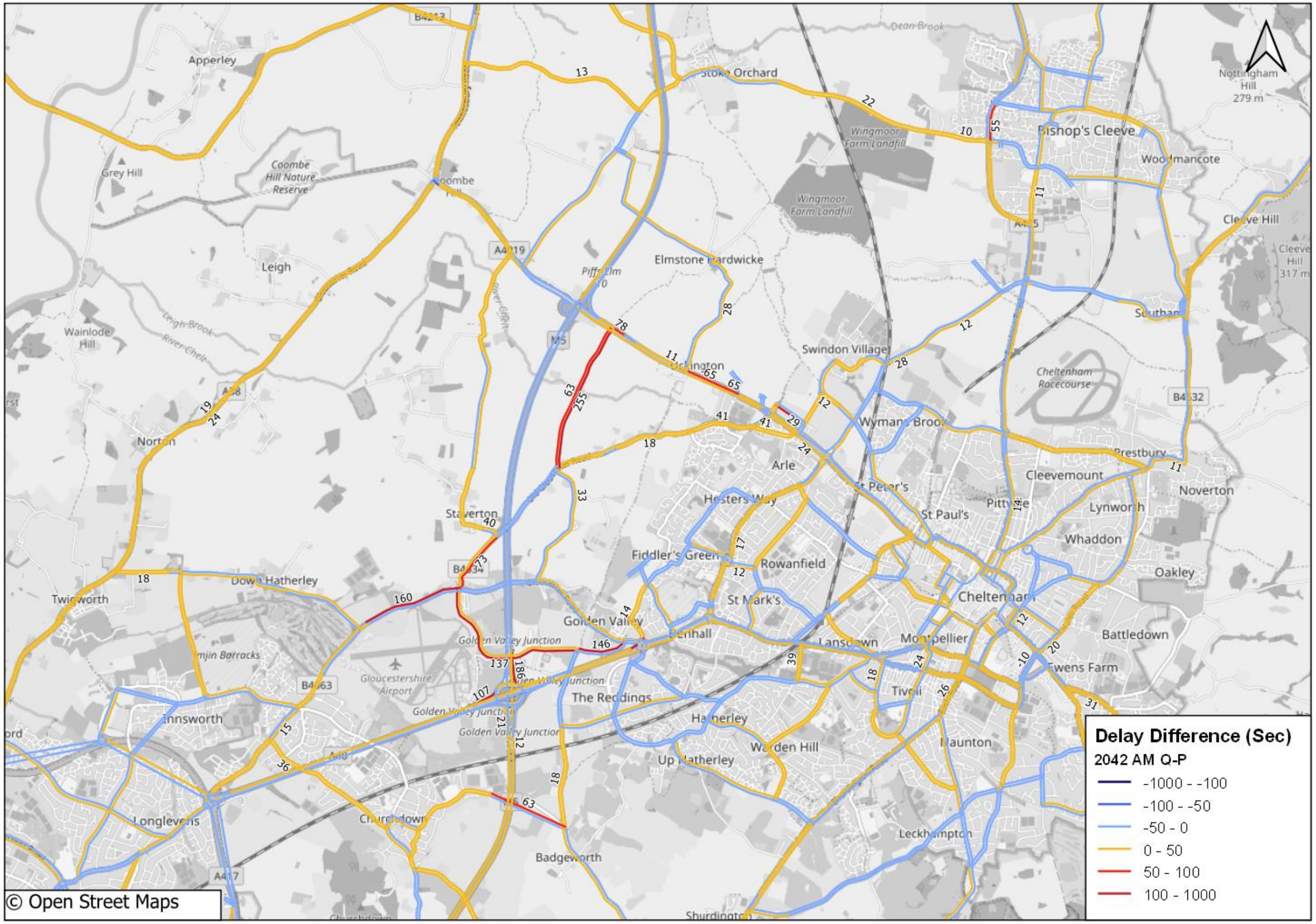

Figure E5 - Link Delay Difference Plot - 2042 Q vs P AM Peak (Seconds)

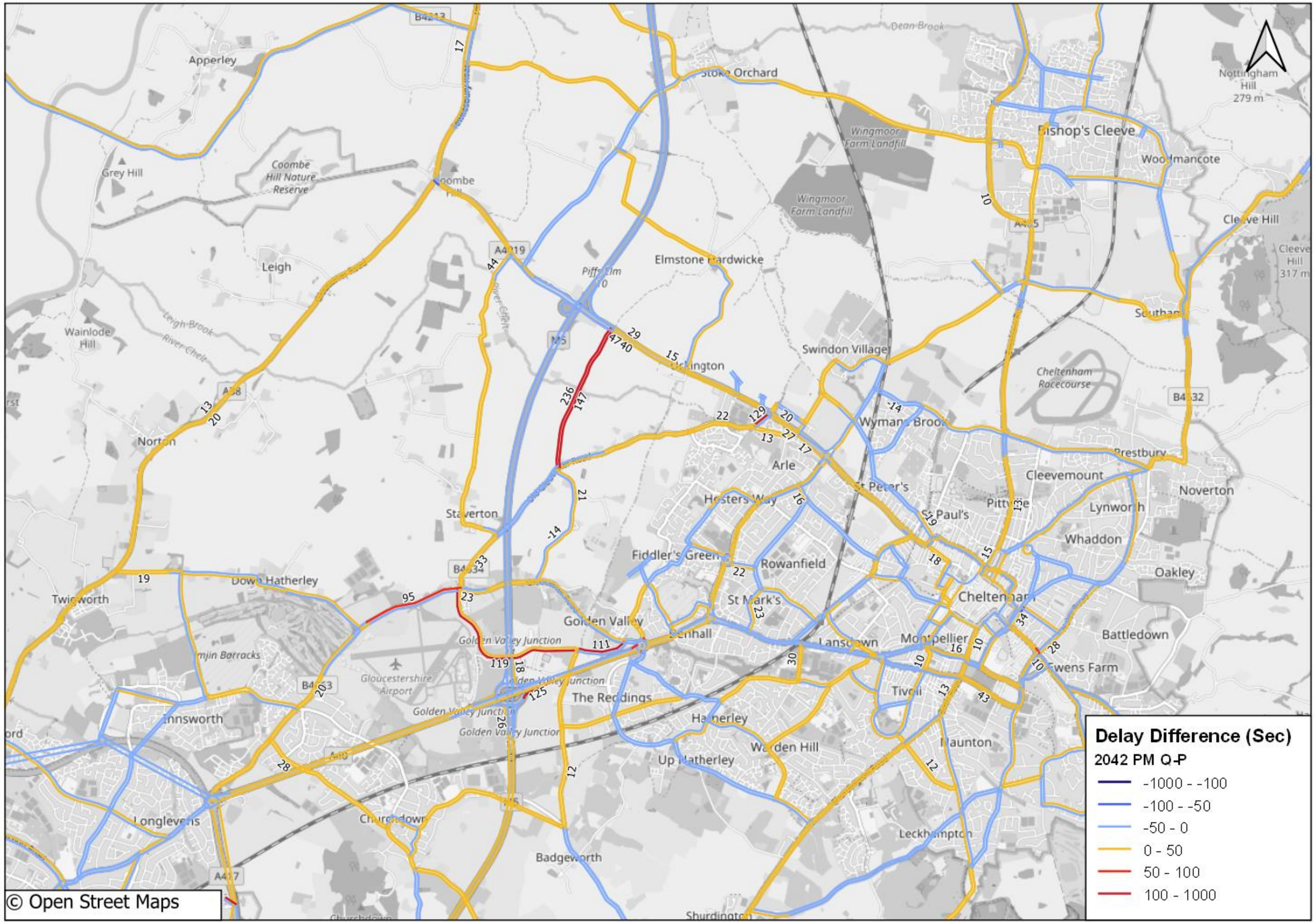

Figure E6 - Link Delay Difference Plot - 2042 Q vs P PM Peak (Seconds)

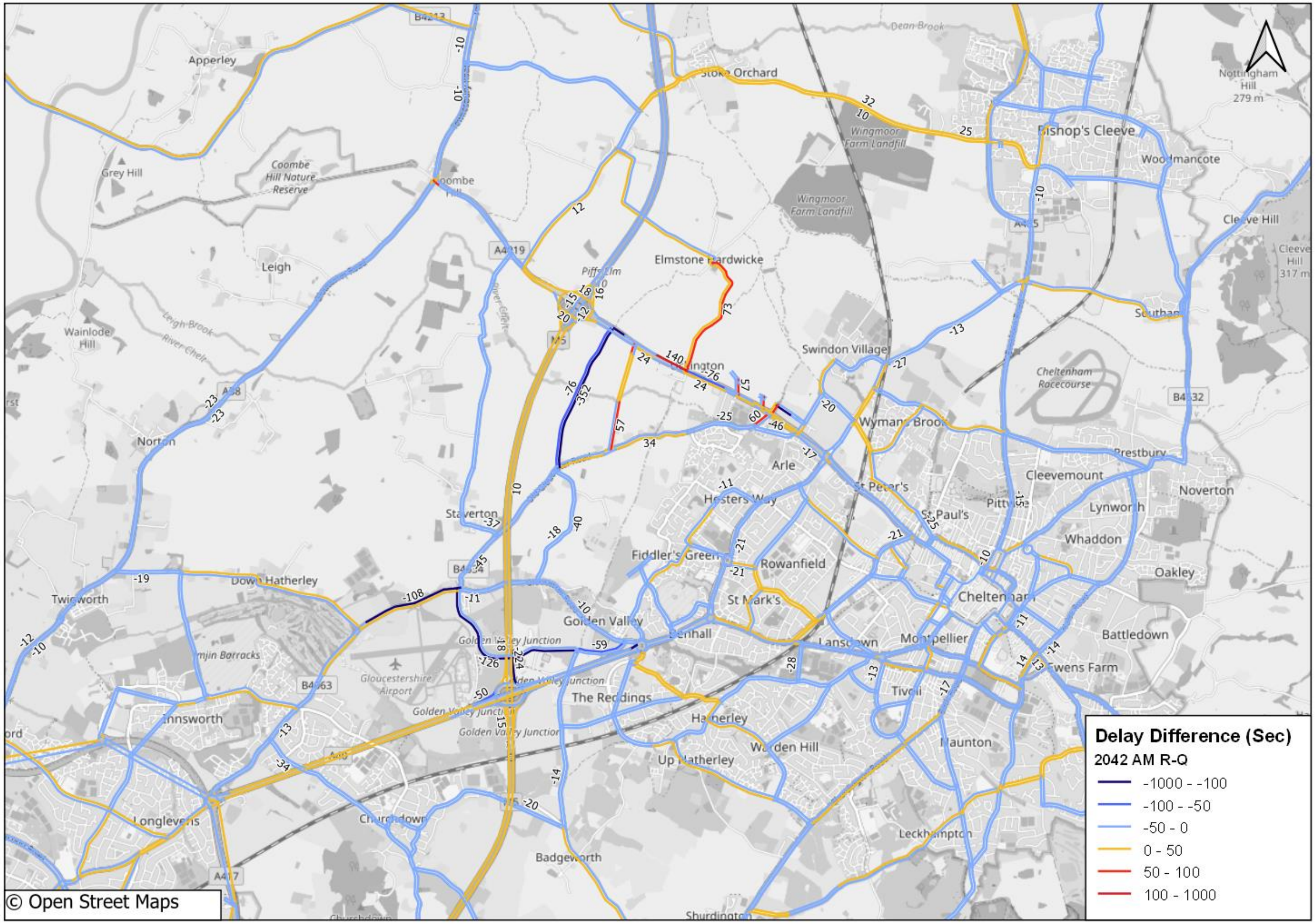

Figure E7 - Link Delay Difference Plot - 2042 R vs Q AM Peak (Seconds)

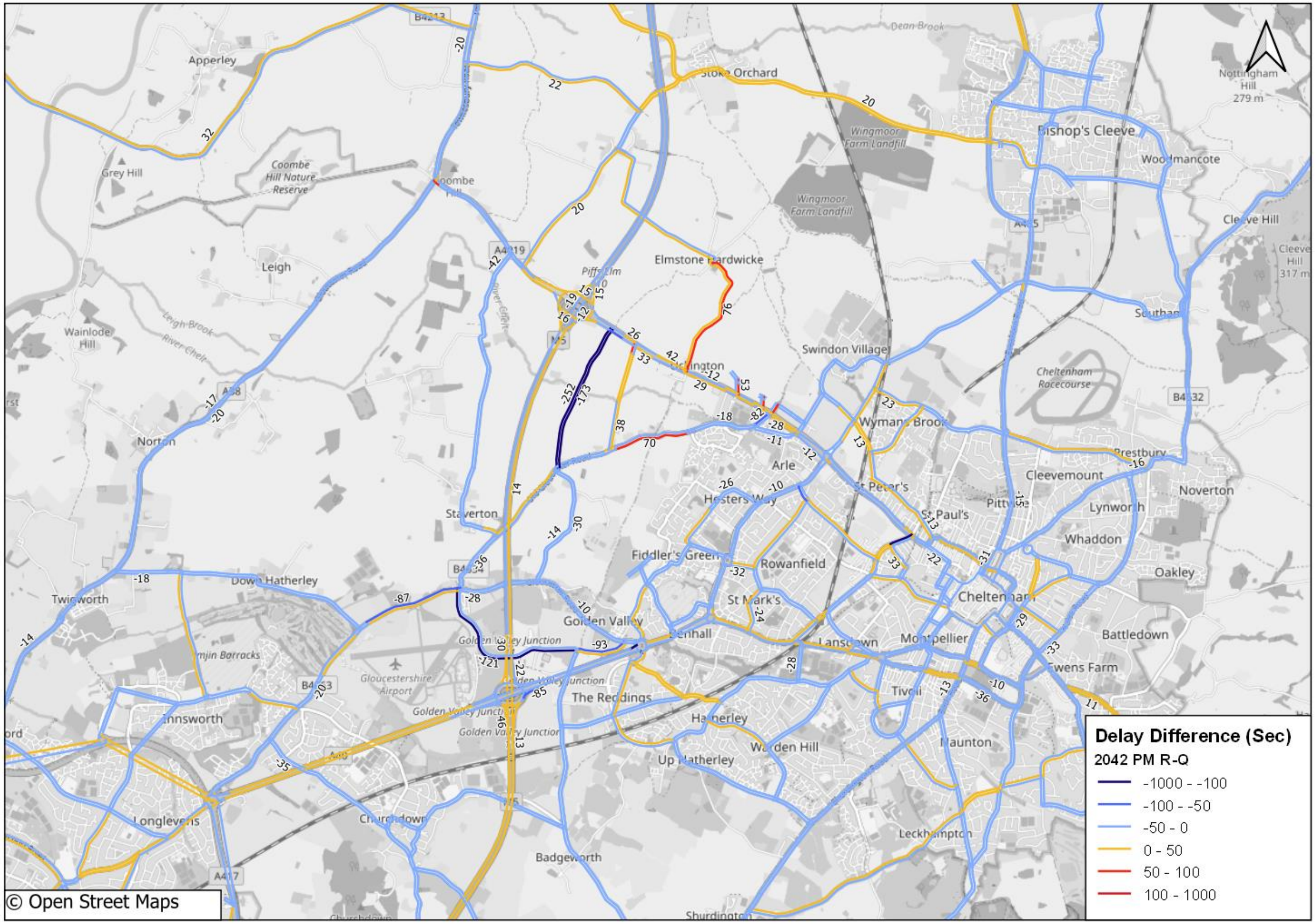

Figure E8 - Link Delay Difference Plot - 2042 R vs Q PM Peak (Seconds)

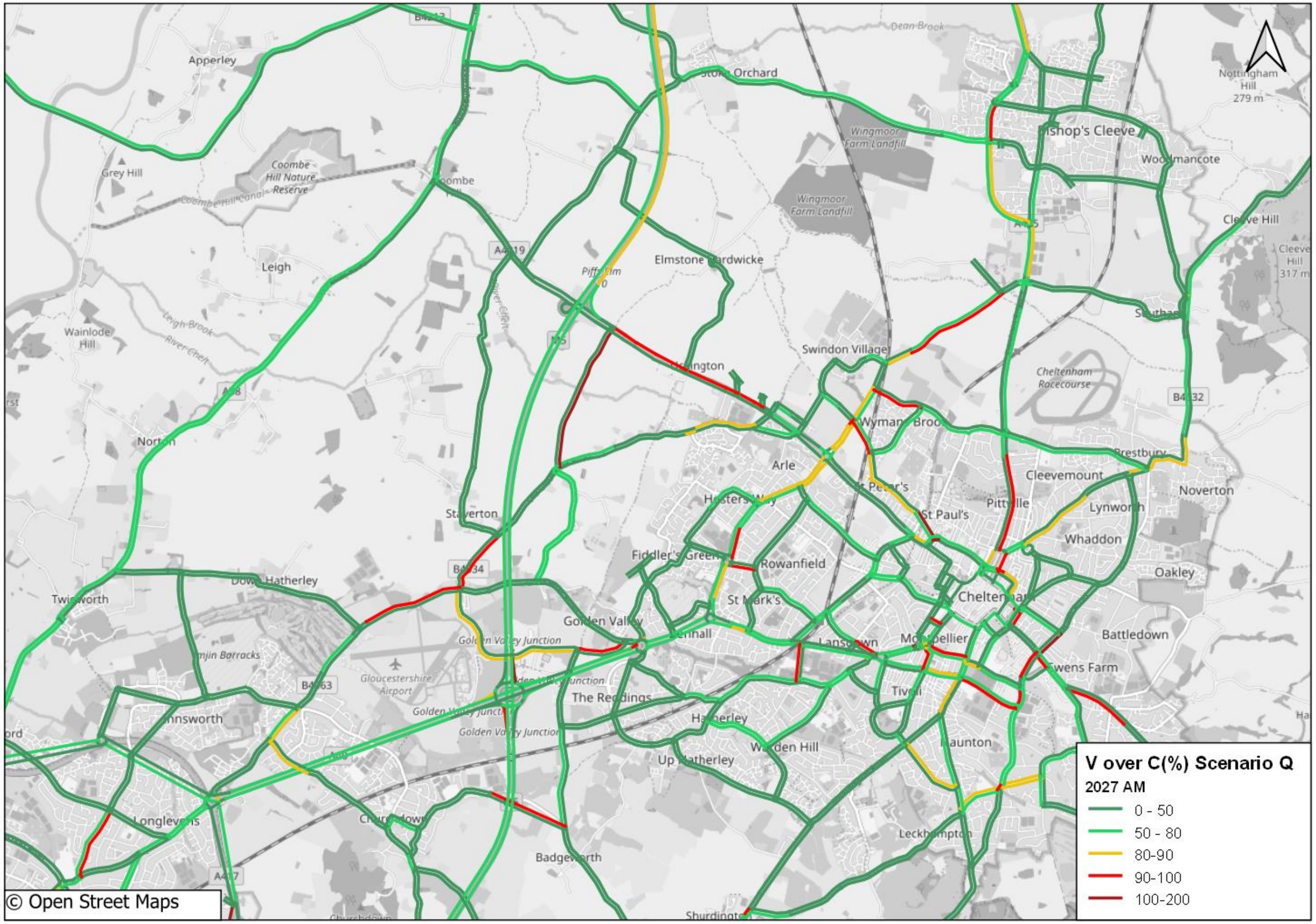

Figure E9 - Volume over Capacity Ratio (V/C) - 2027 Q AM Peak

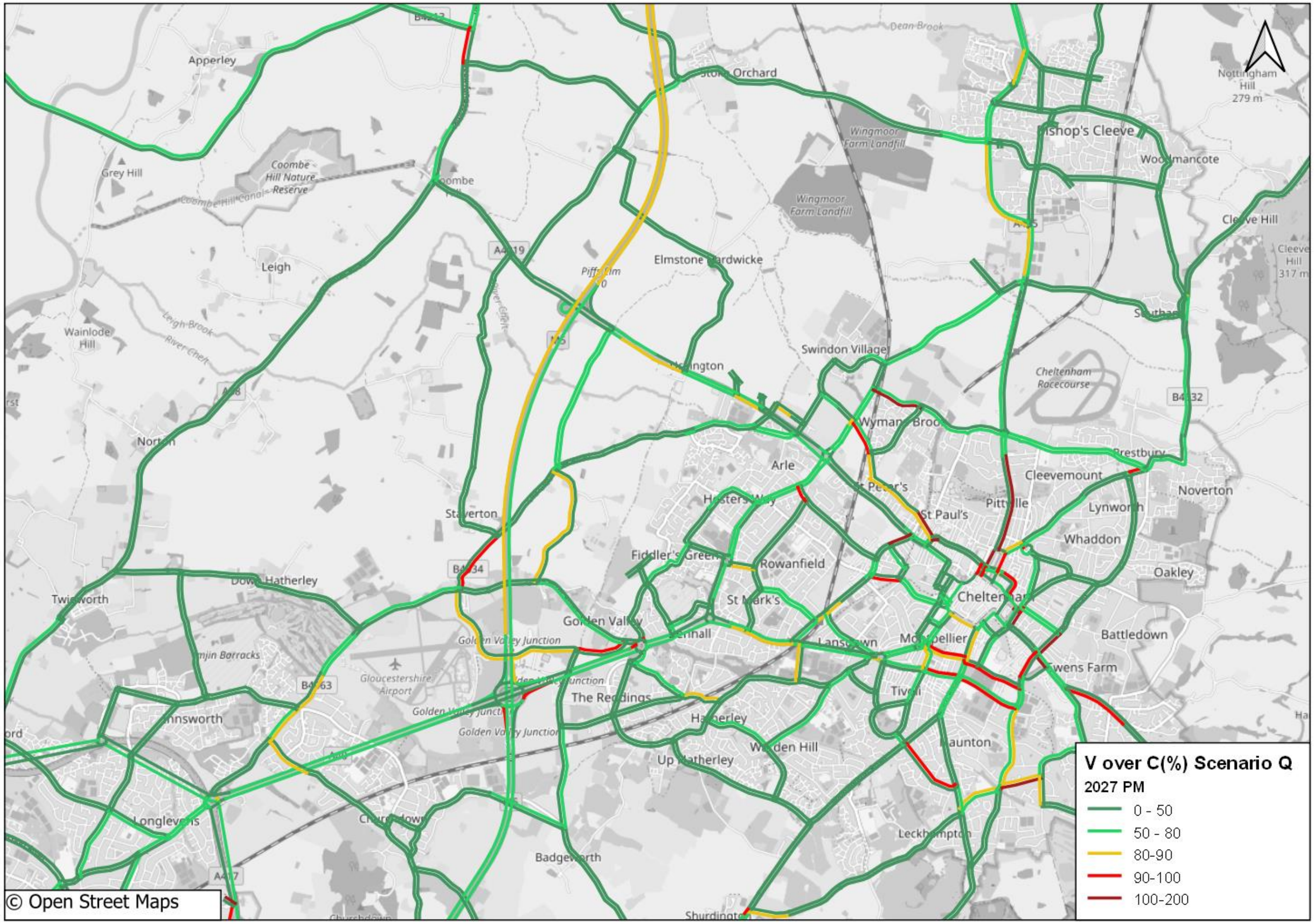

Figure E10 - Volume over Capacity Ratio (V/C) - 2027 Q PM Peak

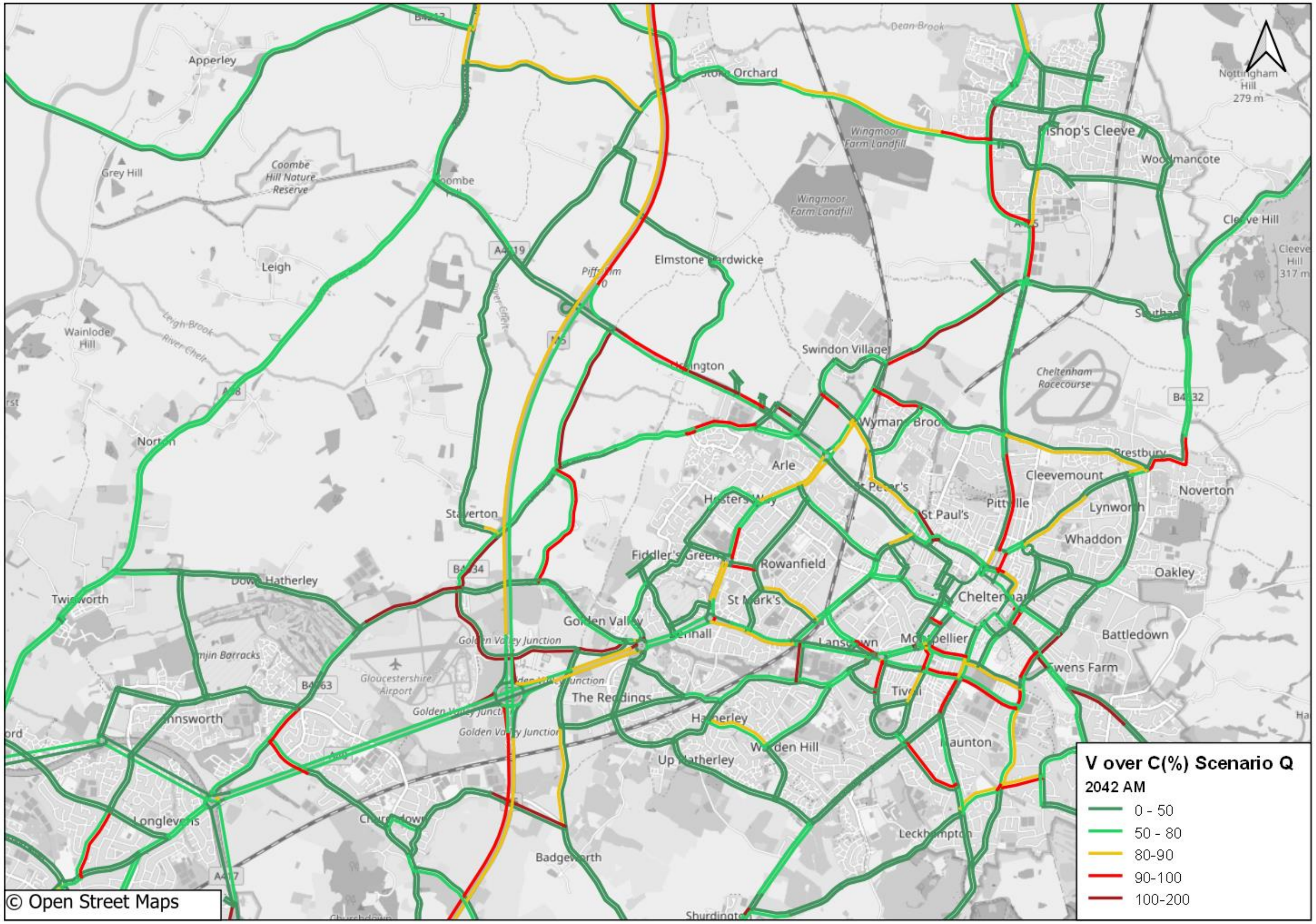

Figure E11 - Volume over Capacity Ratio (V/C) - 2042 Q AM Peak

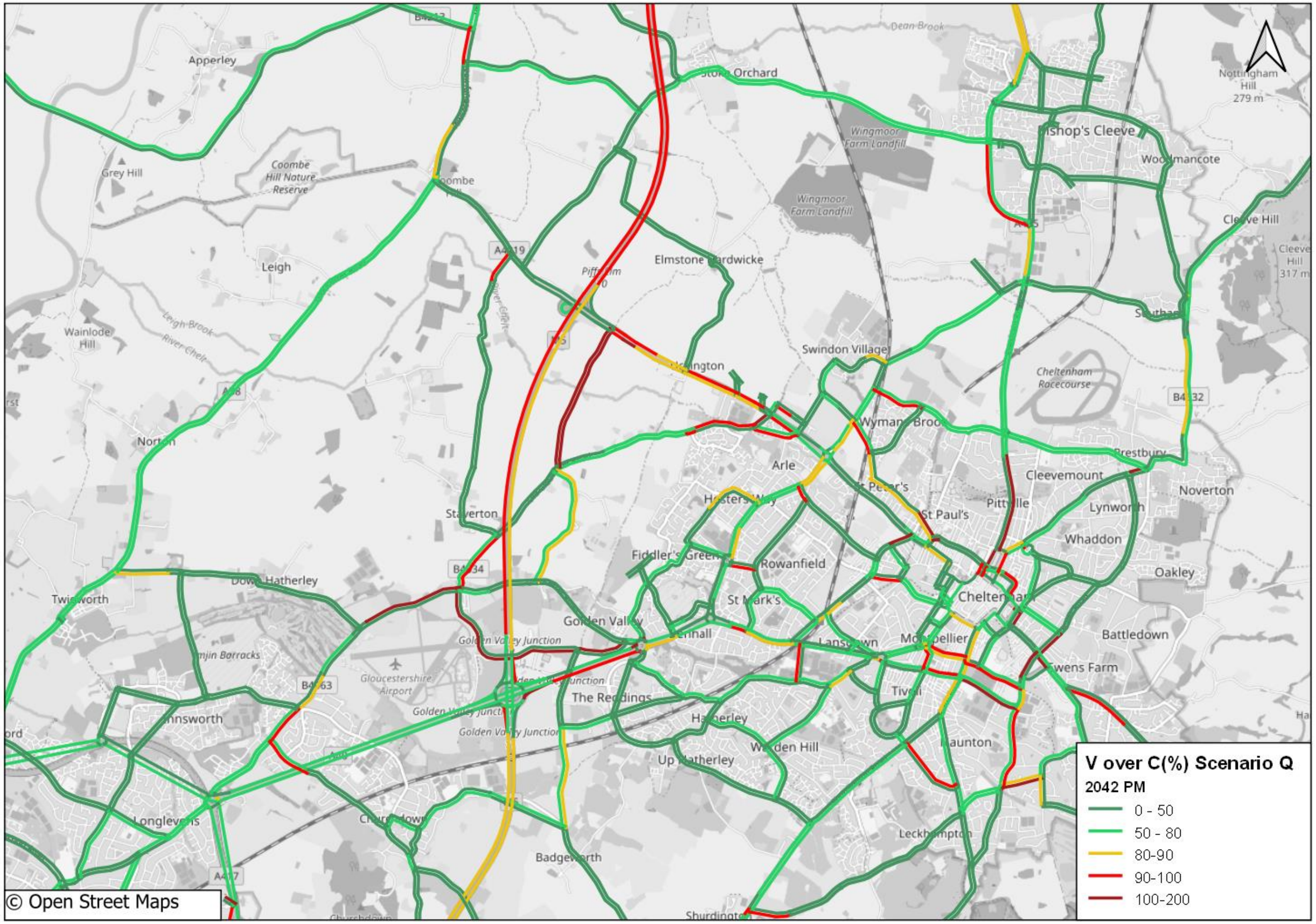

Figure E12 - Volume over Capacity Ratio (V/C) - 2042 Q PM Peak

Key Findings

E.3.6. The traffic flows, delay and V/C plots in 2042 (design year) show expected and consistent patterns under the two sets of comparative scenarios i.e., Q v P which displays the impact of the demand by the trips generated by the dependent parts of JCS developments, and R v Q which shows the changes across the network from provision of the proposed scheme for the same level of demand.

E.3.7. Comparison of Q v P scenarios shows that in absence of the proposed scheme, the additional trips generated by the dependent developments of the JCS sites would lead to diversion of traffic from the M5 between J11 and 10 onto the A38, Old Gloucester Rd and Princess Elizabeth Way as well as local roads around Cheltenham which in turn leads to increases in traffic flows along these routes.

E.3.8. Comparison of R v Q scenarios shows the converse of Q v P trend as the presence of the scheme leads to a more efficient and balanced network in the focus area with traffic reduced along the A38, local roads and Old Gloucester Rd and Princess Elizabeth Way and local roads whilst the flows along the M5 between J11 and 10 are increased.

E.3.9. The link delays as expected follow the same patterns shown by link flows under the two scenarios i.e., increase in delays along the non-motorway key and local roads without the scheme followed by decreases along them with the scheme present.

E.3.10. The V/C ratios plots shown for both 2027 (opening year) and 2042 (design year) provide a consistent picture as link delay plots with increasing V/C ratios along non-motorway and local roads in absence of the proposed scheme and reduction with the scheme in place.

Network Statistics

E.3.11. The Key network statistics for each of the model scenarios have been extracted and included in Table E1 for the Simulation area of the model network shown below in Figure E11.

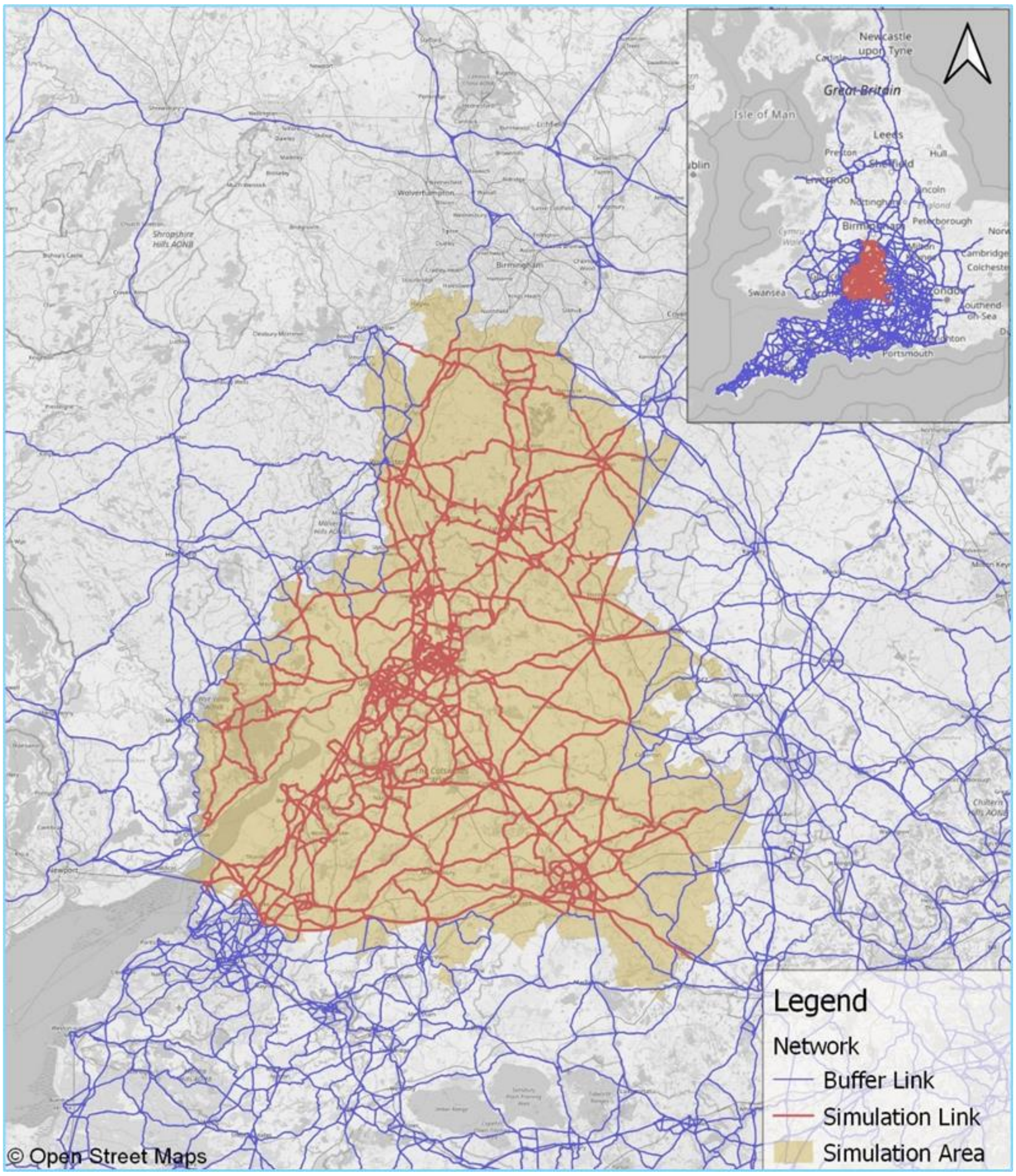

Figure E11 - Traffic Model Network

Table E1 : 2042 Network Statistics for the Simulation Area of the Model Network

Network Statistics	AM Peak				Inter Peak				PM Peak			
	Scenarios				Scenarios				Scenarios			
	P	S	Q	R	P	S	Q	R	P	S	Q	R
Total Assigned Trips (PCUs)	2,293,659	2,293,659	2,297,583	2,297,645	1,813,229	1,813,229	1,816,027	1,816,079	2,367,837	2,367,838	2,371,613	2,371,679
Travel Time (PCU-hrs)	71,505	71,310	73,723	73,263	60,219	60,141	61,346	61,215	73,650	73,514	75,670	75,303
Distance (PCU-kms)	4,657,072	4,657,919	4,716,909	4,713,884	4,213,242	4,210,543	4,253,122	4,250,771	4,700,009	4,699,211	4,758,974	4,753,575
Journey Speed (kph)	65.1	65.3	64.0	64.3	70.0	70.0	69.3	69.4	63.8	63.9	62.9	63.1

E.3.12. It is worth noting that the total demand would remain same for Scenarios P & S and similarly for Scenarios Q & R. Variable Demand Modelling (VDM) was undertaken only for Scenario Q. The demand for other scenarios i.e., P and S was derived from Scenario Q post VDM demand matrices.

E.3.13. The trends shown in Table E1 above are as expected for all indicators. The trend in the average network speed in below Figures (E12 to E14) shows that the network speed remains almost the same between Scenarios P v S and Q v R.

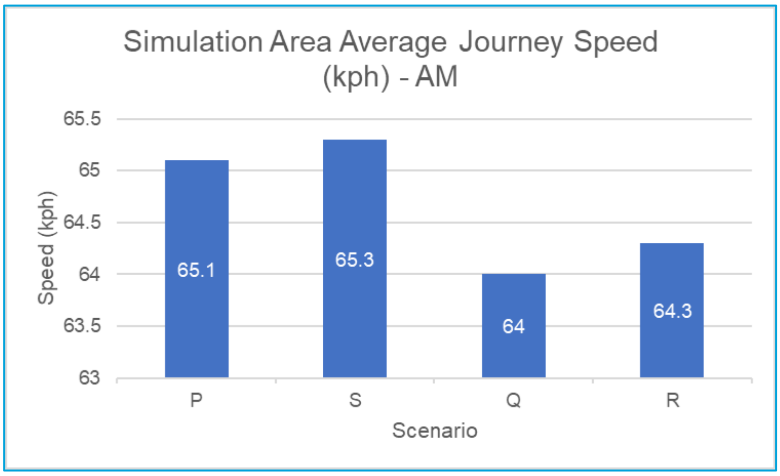

Figure E12 - 2042 AM Peak - Simulation Area Journey Speed

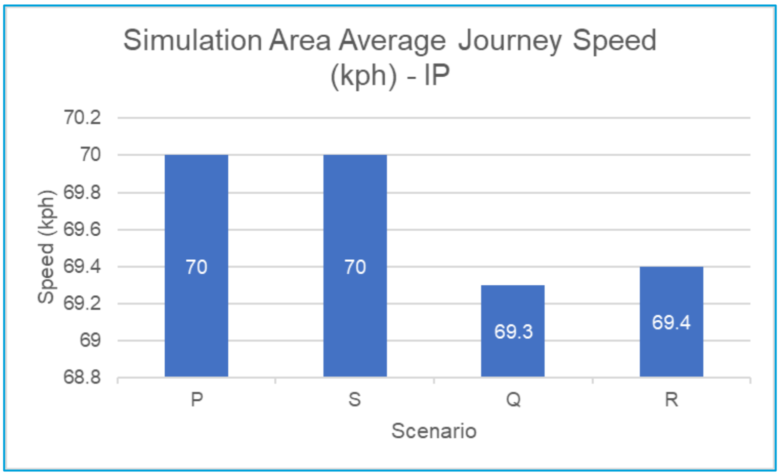

Figure E13 - 2042 IP - Simulation Area Journey Speed

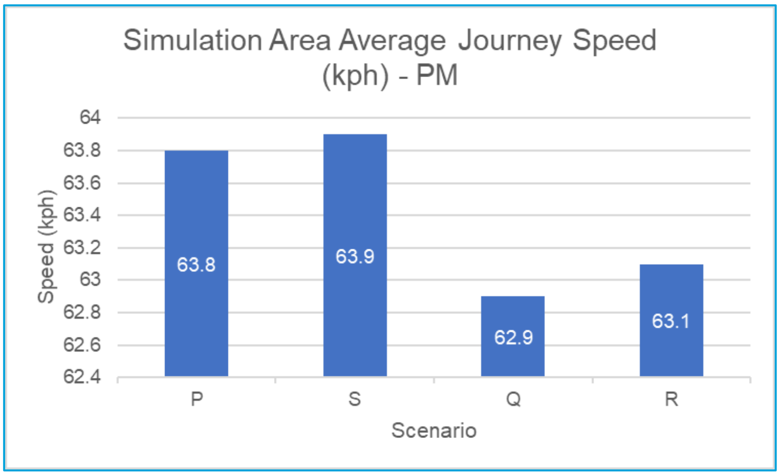

Figure E14 - 2042 PM Peak - Simulation Area Journey Speed

E.4. Dependency Test

Overview

E.4.1. The Dependency Test was carried out by Amey Consultants for the M5 J10 scheme as part of the Traffic Forecasting Report in 2019 to support the successful HIF submission by Gloucestershire County Council.

E.4.2. The recommended method for determining scheme-dependent development is based on comparing two modelled scenarios, as follows:

- With full Joint Core Strategy (JCS) development (TAG scenario 'Q'); and
- With no JCS development (TAG scenario 'baseline');
- Identifying the presence of development trips using 'select-link' O-D trip analysis; and
- Calculating the amount of traffic that has to be removed from scenario Q to achieve an uplift on the Baseline flow that remains within the Level of Service (LoS) threshold.

E.4.3. However, the model re-assignment mechanism referred to above means that quantifying the true extent of scheme-dependent development is very difficult, since even when scheme-dependent trips are removed using the select-link approach and when only the 'deadweight' remains, traffic may be displaced back on to the relieved routes, which will reduce the expected LoS improvement such that LoS remains above the acceptable threshold.

Methodology for Dependency Test

E.4.4. The key steps involved in the dependency test undertaken in 2019 are detailed below

1. Select the core skeleton highway network components on which forecast scenario performance, level-of service (LoS) and operational 'stress' will be judged;
2. Specify a range of acceptability for the indicators of network stress, from which JCS impact severity is then judged;
3. Run future year forecast traffic model assignments for AM/IP/PM periods, at design year;
4. Calculate equivalent Annual Average Daily Traffic (AADT) flows;
5. Calculate the guideline Congestion Reference Flow (CRF) on each link section of the core skeleton highway network;
6. Undertake 'select-link' analysis on each 'critical' link in scenario 'Q' (full JCS), to identify the component origin to destination (O-D) trips that constitute each link flow; and
7. Calculate 'deadweight' scenario 'P', as a derivative from scenario 'Q' above and which excludes the scheme-dependent element of demand.

Sensitivity Tests

E.4.5. Two sensitivity tests were undertaken to establish the impact of varying the quantum of deadweight on the scheme value for money indicator. For this purpose, the quantum of deadweight developments at all three JCS sites was varied by +/- 20% compared to the core scenario. This is considered an over-robust assumption as it is unlikely that such a variation would occur if the dependency test was repeated with the current traffic model.

E.4.6. Two new scenarios representing Scenarios "P" and "S" were developed for all three forecast years and modelled time periods. Assignments for the new scenarios "P" and "S" were undertaken for all time periods and traffic flows across the model area were compared against the core scenario for the same scenario.

E.4.7. The results of comparison of traffic flows between the core scenario and sensitivity tests under the same scenario show that varying the amount of deadweight developments by 20% leads to very little changes in link flows across the model area.

E.4.8. The overwhelming majority of links in the models show differences below 20 PCUs with a small number of links showing values between 50 and 70 PCUs which account for a small percentage of flows along these links.

E.4.9. Given the very modest changes in traffic flows reported across the model area by the sensitivity tests outlined above, it is unlikely that the performance of the proposed scheme is materially affected by varying the amount of deadweight developments (+/-20%).

Conclusions

E.4.10. The main output demand from the dependency test in accordance with the guidance is for Scenario P which represents the “deadweight” developments in scope. No scenario representing the “dependent developments only” is required for assessment of the enabler schemes such as M5 J10.

E.4.11. It needs to be born in mind that the design for the proposed M5 J10 is based on Scenario R which includes all developments in scope i.e. deadweight plus dependent and the proposed scheme. Therefore, the variation in the amount of deadweight quantum (Scenario P) does not affect the design of the proposed scheme.

E.4.12. The results of comparison of traffic flows between the core scenario and the sensitivity tests under the same scenario showed that varying the amount of deadweight developments by 20% leads to very little changes in link flows across the model area.

E.4.13. It can then therefore be concluded that the overall performance of the proposed M5 J10 as an enabler scheme is not materially impacted on by reasonable variations in the quantum of the deadweight development.

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